1983

Naval aviation IMA repair capability: a readiness to resources approach.

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http://hdl.handle.net/10945/19910

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

NAVAL AVIATION IMA REPAIR CAPABILITY:
A READINESS TO RESOURCES APPROACH

by

Dean R. Merrill

December 1983

Thesis Advisor: A. W. McMasters

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Naval Aviation IMA Repair Capability: A Readiness to Resources Approach	5. TYPE OF REPORT & PERIOD COVERED Master's Thesis December 1983
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Dean R. Merrill	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93943	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93943	12. REPORT DATE December 1983
	13. NUMBER OF PAGES 102
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aircraft Maintenance, Resource Management, Material Requirements Planning, Maintenance Management, NAMP (Naval Aviation Maintenance Program), DSS (Decision Support System), APMS (AIMD Performance Management System), AHP (Analytic Hierarchy Process), NALCOMIS (Naval Aviation Command Management Information System),

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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Block 19 (continued)

NALDA (Naval Aviation Logistics Data Analysis).

Block 20 (continued)

initiatives provide the performance measurement orientation and information processing base required in support of NAVAIR "tactical" planning. It further concludes that complex logistics problems can be "modeled" through the AHP. AHP is a promising technique for integrating performance information and expert opinion into a hierarchical, multiple objective planning structure. It provides a method for determining resource requirement priorities in support of readiness goals. The study recommends that research be expanded to include development of a NAVAIR decision support framework utilizing the AHP.

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Naval Aviation IMA Repair Capability: A Readiness to Resources Approach

by

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Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1983

ABSTRACT

This thesis studies intermediate repair planning at the Naval Air Systems Command (NAVAIR) level. Maintenance information system initiatives (Naval Aviation Logistics Command Management Information System (NALCOMIS)/Naval Aviation Logistics Data Analysis (NALDA)/AIMD Performance Management System (APMS)) and an analytical "systems" model (Analytic Hierarchy Process (AHP)) are examined. The study concludes that information system initiatives provide the performance measurement orientation and information processing base required in support of NAVAIR "tactical" planning. It further concludes that complex logistics problems can be "modeled" through the AHP. AHP is a promising technique for integrating performance information and expert opinion into a hierarchical, multiple objective planning structure. It provides a method for determining resource requirement priorities in support of readiness goals. The study recommends that research be expanded to include development of a NAVAIR decision support framework utilizing the AHP.

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I. INTRODUCTION

A. BACKGROUND

Within weeks of the United States' entry into World War 1, the following discussion took place between destroyer squadron skipper Captain Taussig and Commanding Chief of the British Forces, Admiral Bayly [Ref. 1: p 295]:

(Bayly) "At what time will your vessels be ready for sea?"

(Taussig) "I shall be ready when fueled."

(Bayly) "Do you require any repairs?"

(Taussig) "No, sir."

(Bayly) "Do you require any stores?"

(Taussig) "No, sir. Each vessel now has on board sufficient stores to last for seventy days."

(Bayly) "You will take four days rest. Good morning."

One of the most significant lessons of military history, relearned as recently as 1973 when the U.S. faced a crisis in the Middle East, is one related to capability assessment and resource allocation. Measuring capability, or effectiveness, and effectively allocating resources to improve that capability, are largely dependent on the ability of command echelons to assess realistically the degree of preparedness of subordinate units/commands, correctly identify and communicate their resource requirements, and direct efforts toward an optimal degree of readiness and deployability. The lesson, in and of itself, is easily understood. It

is intuitively obvious that there is some functional interrelationship between resource inputs and output measured in terms of capability. What is not understood is the decision process which determines resource allocations on the basis of an integrated analysis of capability variables. In an age of increasingly complex logistics and increasingly limited budget resources, it is the "readiness to resources" decision process that has become a principal concern of Congress and the Department of Defense(DOD).

Defense program requirements can no longer be explained "...narratively in terms of broad logistics problems..." [Ref. 2: p. 18] and justified on the basis of "...historical trends and the application of experienced judgment..." [Ref. 2: p. 15]. The experiences of the last two decades have driven home the reality of resource constraints. Between 1965 and 1968, escalating costs associated with financing the Vietnam War forced strategic planners to cut back drastically defense capital investment (the Navy purchased 80 percent fewer ships during that period as compared with similar pre-1965 periods). During the post-Vietnam era, a public insistence on genuine cutbacks in defense expenditures coupled with a crippling inflationary spiral forced the Department of Defense (DOD) to "...cut back its force structures, reduce training, slow down force modernization, and accept shortfalls in spare parts..." [Ref. 3: p.27]. More recently, recession-caused budget revenue shortfalls

have forced strategic and tactical planners once again to determine how best to allocate scarce resources.

The budget process, which essentially establishes the program justification requirement, is "...simply an extension of our basic political system" [Ref. 4: p. 277]. As such, budgetary politics reflect the everpresent conflict between agency "advocates" and budget "guardians" and the driving influences of social, political, and economic trends. Inherent in fiscal, political, and allocative objective decisions is the classic "guns versus butter" trade-off. The budget process is not designed to serve "...as a device for national planning" [Ref. 4: p. 277]. Nevertheless, competing agencies lobbying for an increased share have experienced a growing requirement to substantiate a national priority, demonstrate agency program planning, and specifically relate agency output to resource input. With Congress facing a fiscal year 1984 budget proposal of $280 billion in budget authority for the national defense function and outlays expected to approach $245 billion in 1984, $285 billion in 1985, and $323 billion in 1986, it is not likely that the agency program requirement to relate output to input will diminish [Ref. 5: p. 5-8].

In defense of a "controllable" line item in the fiscal year 1976 budget, the Navy attempted to justify a $26.2 million increase in training command flight hour funding by citing a need to improve readiness. In refusing the request,

Congress contended that a readiness deficiency was not discernable from readiness information presented as justification [Ref. 6: p. 33].

The flight hour funding example is representative of the basic problem facing agency office planners. The problem, simply stated, is one of developing at each program level "...credible capability assessment systems that measure output activity versus resource input in terms of readiness" [Ref. 7: p.40].

It is recognized at the outset that there are no simple answers. The readiness to resources problem even within a specific functional area is extremely complex. Nevertheless it seems appropriate that attempts to structure decision information and processes be discussed in an effort to define process variables and identify the interrelationships. While it is unlikely that anyone will discover "...a simple, useable definition of (capability), a means of measuring it, and some perfectly definite input-output relationship" [Ref. 8: p. 21], it is equally unlikely that "new" knowledge is needed. It is felt at the outset that better applications of what is already known can serve to reduce the apparent complexity of large systems to manageable proportions and quantifiable terms.

B. SCOPE AND APPROACH

This thesis studies Naval Aviation Maintenance Program (NAMP) intermediate level repair capability as it relates to

readiness determination and resource allocation at the Naval Air Systems Command (NAVAIR) level. The study focuses on systems command problems relevant to assessing the repair readiness of individual Aircraft Intermediate Maintenance Departments (AIMD'S), determining resource requirements in an effort to improve readiness at the intermediate level, and relating those resource requirements to budget dollars in support of the OPNAV/NAVAIR strategic capabilities planning task.

Specifically, this study deals with "modeling" the Intermediate Maintenance Activity (IMA) readiness to resources problem through an application of the Analytic Hierarchy Process (AHP) to the Logistic Management Institute's AIMD Performance Management System (APMS). Chapter II develops the concept of capability at the congressional, DOD, and NAMP level to establish a "common ground" on term definition. Chapter III provides an overview of the NAMP and a description of the intermediate level repair/supply/information process. Chapter IV coordinates the information contained in chapters II and III through a discussion of NAMP maintenance data system (MDS) initiatives/shortfalls and their relationship to the planning tasks assigned to Navy offices. Chapter V discusses decision theory and decision support systems. Chapter VI discusses current AIMD performance measures and development of the Logistic Management Institute's (LMI's) AIMD Performance Management System (APMS). Chapter VII incorporates APMS into

the "readiness" taxonomy presented in chapter II. Application of the Analytic Hierarchy Process (AHP) to the taxonomy is discussed as a potentially valuable technique for developing a NAVAIR tactical planning decision support system. Chapter VIII presents conclusions and recommendations.

II. THE CAPABILITY CONCEPT

A. GENERAL

The basis for the process of allocating "scarce" resources is the determination of priority between various and competing system requirements. While that seems relatively simple, it is not. The determination of priority assumes, in the first place, that there is an understood objective based upon, secondly, a systematic measurement process. Throughout chapter I, the terms capability, readiness, force effectiveness, and preparedness were used interchangeably. That was not done to create a definitional issue. There is no single dimension that captures all that is meant by the term capability. In some defense articles capability is used interchangeably with readiness while in others a distinction is made between readiness and sustainability as separate components of capability.

Admiral Thomas B. Hayward in a prepared statement presented to the Senate Armed Services Committee in support of the fiscal year 1983 Defense Authorization for Appropriations stated "...nothing is more relevant to the (capability) of our naval forces to carry out their assigned mission in peace or war than their state of readiness, in all its ramifications." That statement implies that readiness is a multi-dimensional element of capability. The statement

assumes a "universal" understanding of both capability and readiness. In fact, a great deal of confusion still exists. The lack of understanding is apparent in the absence of a clearly defined "capability" objective at the strategic program level and a consequent absence of "agreed upon" "readiness" measures at the tactical planning and operational control levels of management. Poorly defined objectives and inadequate performance measures have compounded tremendously the complexities associated with the already difficult decision processes involving trade-offs between investments in equipment, manpower, training, operations, maintenance, and logistics support.

B. CAPABILITY DEFINED

In developing the concept of capability, it is necessary, at the outset, to present a premise that will be developed throughout the chapter. The premise is that "capability" is "readiness over time". Readiness is based on the understanding that "...wars are fought in the present, not in the future... (and) should be viewed from a short term perspective..." [Ref. 9: p. 67]. Capability is "...the more inclusive concept" [Ref. 3: p. 2]. It is a strategic concept in the sense that it recognizes a changing environment and projects readiness requirements planning into the future. While not precise, this distinction has been accepted by the Joint Chiefs of Staff (JCS). They define readiness as

"...the degree to which the organization is capable of performing the missions for which it was organized or designed" [Ref. 10: p. 7-2].

C. HISTORICAL/LEGISLATIVE BACKGROUND

A discussion of several historical and legislative references to "readiness" identifies specific dimensions of the term and serves to illustrate elemental aspects of the "capability" concept.

Admiral Bayly clearly viewed the readiness of Captain Taussig's destroyer as conditional on the unit's ability to operate at sea. In 1954, Admiral Jerauld Wright, during his tour as Commander in Chief, U.S. Atlantic Fleet, insisted that his Command's primary mission was to "...be ready to fight a war tomorrow morning before breakfast." Along the same lines, Admiral "Cat" Brown, during his tour as Commander, U.S. Sixth Fleet in 1956, considered readiness to be related to requirements associated with the problem of keeping the fleet alive and fighting for at least forty-eight to seventy-two hours after the commencement of open hostilities. What underlies all three examples is, first, a dimension concerned with a units'/forces' ability to perform at the start and, second, a dimension concerned with how long the unit/force can sustain a given level of performance. Certainly at an operational level, these two dimensions, preparedness and sustainability, drive assessments. Implied in the examples,

however, are two additional dimensions. It is reasonable to expect that each unit commander, prior to assessing degrees of preparedness and sustainability, had considered the existing threat environment and, in that regard, previously evaluated the dimensions of force structure and force modernization.

The four readiness dimensions presented in Figure II-1 constitute an assumption fundamental to the remainder of this study. The assumption is that readiness is a tactical objective made up of four objective elements - preparedness, sustainability, force structure, and force modernization. This assumption is based on the readiness elements identified in a 1980 study by the American Enterprise Institute entitled The Problem of Military Readiness (see reference list). It is interesting to note that, while the objective elements are "unofficial", they form the definitional basis for a 1982 U.S. Government Accounting Office report entitled Evaluation of DOD's Readiness Report in Response to Public Law 96-342 (see bibliography).

The four readiness objective elements considered separately do not provide an adequate understanding of the term. If they did, it would be relatively easy to weight the dimensions, measure each, and develop an overall index. Readiness "...focuses on systems taken as a whole, not on their parts taken separately" [Ref. 11: p. 27]. As such, there are some properties which are derived "...from the

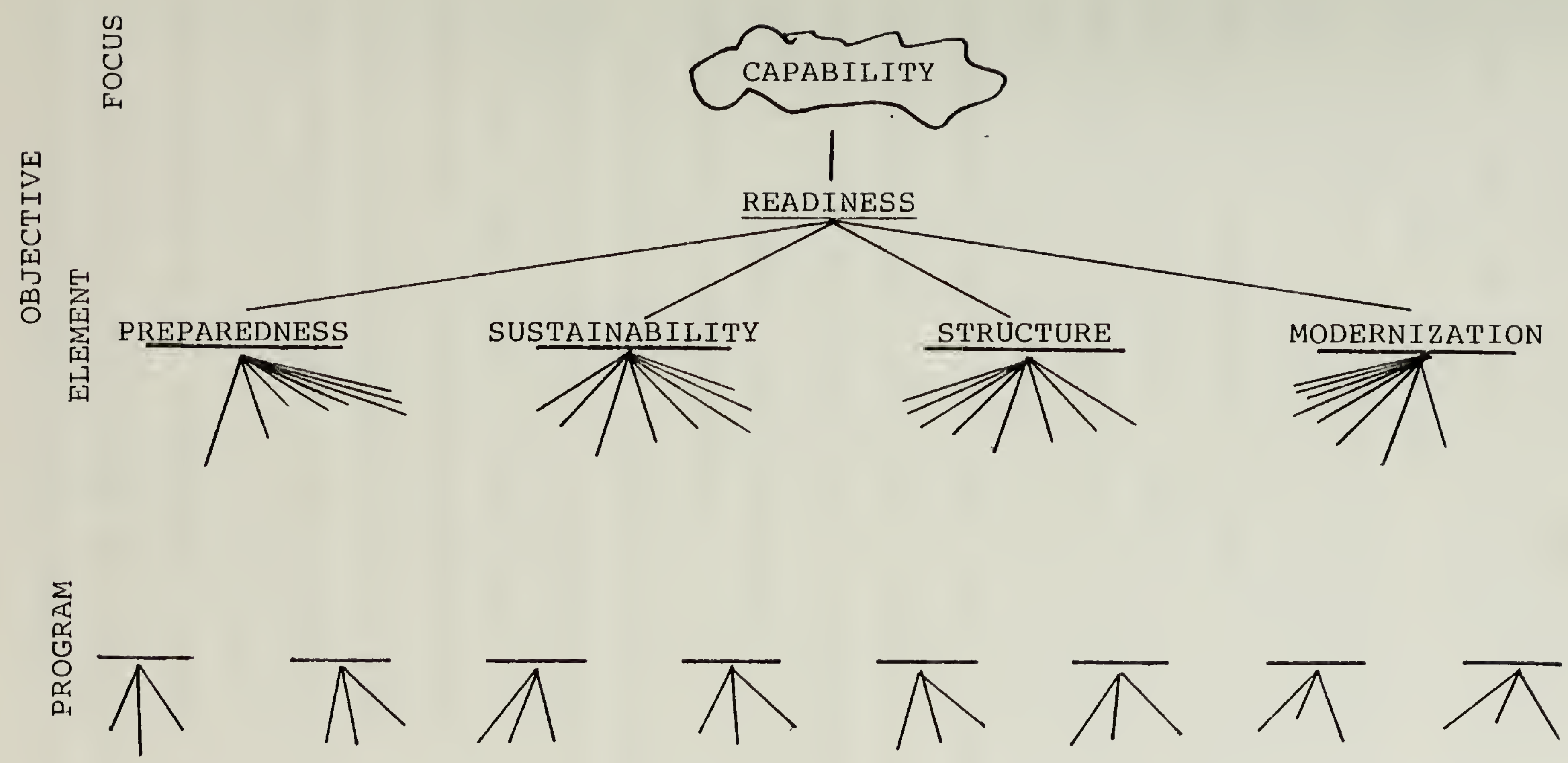


Figure II-1. Readiness Taxonomy

relationships between parts of the system: how the parts fit together and interact" [Ref. 11: p. 27]. In assessing the readiness of a system, the effect of degraded performance by any subsystem must be analyzed in terms of its relationship to every other subsystem.

Legislative attempts to deal with readiness began in 1977 with the publication of Senator John C. Culver's report entitled "The Readiness Crisis". Citing the low "readiness" of U.S. combat forces, Senator Culver attributed readiness problems to an overemphasis by DOD planners on force modernization. He recommended that a higher priority be assigned to improved combat readiness and the monitoring of readiness indicators. One significant element of Senator Culver's report was his recognition of "readiness" as "...a somewhat imprecise concept, incorporating both quantitative and qualitative judgments"[Ref. 12: p.3].

Senator Culver's report led the Senate Armed Services Committee to recognize "...significant differences...in... readiness reporting criteria" and the often impossible task of relating "...proposed expenditures to specific, planned changes in readiness"[Ref. 13: p. 140]. In late 1977, congressional passage of the fiscal year 1978 Defense Authorization Act, Public Law 95-79 Section 812, established the requirement that "...the budget of the Department of Defense ...include data projecting the effect (on readiness) of the appropriations requested for material readiness requirements.

In 1980, with the passage of Public Law 96-342, the reporting requirement was extended beyond material readiness to include data projecting unit combat readiness with regard to funds requested. While the latter requirement was rescinded with the passage of Public Law 97-86, it was rescinded because of the tremendous definitional and assessment method problems that agencies were experiencing and not because the requirement was not considered important. The material readiness reporting requirement still exists. It is clearly understood by Congress and the DOD that the intent and direction is toward a complete system that shows the "...readiness effect of funding alternatives"[Ref. 2: p. 15].

D. PERSPECTIVE

Congressional inquiries relevant to "What is readiness?", "How much does it cost to maintain?", and "How much more readiness will "X" dollars buy?" are forcing the development of quantitative readiness measures. Proxy measures, such as operationally ready (OR)/mission capable (MC) rates and experienced judgment, are being challenged as inadequate program justification measures.

A standard resource-to-readiness methodology still does not exist largely because of the definitional problem. In hearings before the Senate Armed Services Committee on the fiscal year 1983 DOD Authorization for Appropriations, Admiral Harry Train, Commander in Chief, U.S. Atlantic Fleet,

stated that in assessing fleet "capabilities" he focused on "personnel, readiness, and sustainability." Admiral James Watkins, Commander in Chief, U.S. Pacific Fleet, on the other hand, saw capability as unconstrained, "readiness" as "... what percentage of unconstrained capabilities..." could be brought to bear, and readiness measurement as requiring a "...complex blending and interpretation of many indices" [Ref. 14: p. 3075].

A final point establishes the transition from national objectives to Naval Aviation Maintenance Program (NAMP) objectives and the subject of this study. Underlying each example is a basic mission or functional orientation. Restating the JCS definition of readiness, the DOD Readiness Management Streering Group defines unit readiness as "... the ability of a force, unit, ship, weapon system or equipment to perform the function for which it was organized or designed" [Ref. 15: p. 3].

The NAMP "...provides an integrated system for performing aeronautical equipment maintenance and all related support functions"[Ref. 16: p. 1]. In keeping with the concepts developed thus far, the program is mission oriented in its direction, "dynamic" in its concept "...to support the Chief of Naval Operations' (CNOs') ...objectives..." (capability), and structured in its organizational objective to govern the "...management of organizational, intermediate, and depot level aviation maintenance"[Ref. 16: p. 1-1-1].

A system for modeling the readiness to resources relationship is presented in subsequent chapters. It must be understood prior to that presentation that strategic "capability" is developed in response to mission requirements imposed by an environmentally sensitive "operational concept". Readiness is the objective, or mission goal, which is determined once the operational environment has been defined. In Naval aviation maintenance, the readiness objective is to provide the material support required to meet aircraft "mission capable" goals. Structured readiness/ resource requirements information and performance measurement systems are essential to that objective.

III. THE NAMP AND INTERMEDIATE REPAIR

A. BACKGROUND

The Naval Aviation Maintenance Program (NAMP) was established in October, 1959 to provide an integrated system for performing aeronautical equipment maintenance and all related support functions. Because it is dynamic in nature, current policies, procedures, and responsibilities for Naval Aviation maintenance are the result of numerous changes and several major revisions to the basic program document, OPNAVINST 4790.2. Major revisions include: (1) introduction of the three-level maintenance concept; (2) incorporation of maintenance data collection, man-hour accounting, and aircraft accounting systems through the introduction in 1965 of the Naval Aviation Maintenance and Material Management (3M) system; (3) development, in 1970, of a cohesive, command oriented publication; and, (4) a fundamental format change in 1977.

B. ORGANIZATION

Administration and support for the NAMP are accomplished through the chain of command. Responsible for the achievement of maximum operational readiness of Naval Aviation systems in support of missions assigned by the Secretary of the Navy, CNO has "...provided the basis for the NAMP and ...established policies for the assignment of maintenance responsibilities to all activities of the naval establishment concerned with the maintenance of naval aircraft"[Ref. 16: p. 2-1-1].

Command responsibilities are assigned by CNO to Aircraft Controlling Custodians (ACC's), including air type commanders (Commander, Naval Air Force Atlantic/Pacific) under their respective fleet commanders, Chief of Naval Reserve, Chief of Naval Air Training, and Commander Naval Air Systems Command (NAVAIR). ACC's serve as coordinating authorities for the NAMP in the operating/training forces and maintain responsibility "...for the maintenance and material condition of aeronautical equipment assigned to their cognizance"[Ref. 16: p. 1-3-1]. Specifically, the responsibility includes (1) "...the accomplishment of repair of aeronautical equipment and material at the level of maintenance which will ensure optimum economic use of resources..." and (2) the "...use of pertinent data in order to effectively improve material condition and safety" [Ref. 16: p. 4-1-1]. Responsibility for the coordination of maintenance performed by squadrons/ units is assigned by ACC's to specific commanders, functional wing, fleet air wing, and carrier air wing commanders. Line responsibility for the maintenance and material condition of assigned aircraft rests with squadron commanding officers.

Support responsibility is assigned by CNO to the Chief of Naval Material (CNM). The CNM delegates specific responsibilities for aviation maintenance to NAVAIR while retaining responsibility for "...coordinating, monitoring, and appraising Naval Material Command actions to provide effective aviation maintenance support..." [Ref. 16: p. 1-3-6]. NAVAIR

support responsibilities include "...coordinating authority for the conduct of the NAMP...,technical direction in matters concerning naval aircraft...and associated material..., (and) command and support responsibility over the Naval Aviation Logistics Center (NALC)" [Ref. 16: p. 1-3-6]. NALC is primarily tasked with coordinating and managing depot level maintenance activities. The Aircraft Intermediate Maintenance Support Office (AIMSO) is tasked with developing "...policies, programs, and procedures to achieve optimum material readiness, safety and economy in the application of all NAMP resources at the intermediate level of maintenance: [Ref. 16: p. 1-3-8].

C. MAINTENANCE LEVELS/SUPPLY SUPPORT

The need for an integrated maintenance/supply system capable of responding simultaneously to the "readiness" and "resource management" goals of the command/support organization structure led to implementation of the three-level maintenance concept. Under the concept and in support of the primary ACC responsibility, repair of aeronautical equipment and material is accomplished at either the organizational, intermediate, or depot level. Briefly described, specific responsibilities of each level are as follows.

1. Organizational Level

Organizational maintenance is defined as those equipment upkeep functions normally performed by maintenance personnel on a day-to-day basis in support of squadron operations. Functions assigned to the Organizational

Maintenance Activity (OMA) include equipment inspection, servicing, and handling as well as "on equipment" corrective and preventive maintenance, technical directive incorporation, and organizational level record keeping/reporting.

2. Intermediate Level

Intermediate maintenance, often refered to as "I" level repair, is maintenance performed by designated activities in support of operating squadrons. Maintenance actions performed by the Intermediate Maintenance Activity (IMA) include calibration; "off equipment" repair/replacement; repair/replacement of damaged or unserviceable parts, components, or assemblies; accomplishment of certain periodic inspections; and manufacture of certain nonavailable parts.

3. Depot Level

Depot level maintenance is performed at depot facilities (organic or contract). Maintenance actions performed at the Depot (DOP) constitute "rework" of materials requiring major overhaul and include the complete rebuilding of parts, sub-assemblies, assemblies, and end items, parts manufacture, equipment modifications, and reclamation. Depots support organizational and intermediate level maintenance activities through engineering assistance and the performance of maintenance beyond the capability of the lower level activities.

Supply support for the three-level concept is based on a direct relationship between maintenance and supply elements. All maintenance organizations, regardless of size, have an

assigned supply activity to which material requests can be directly submitted. The achieved level of integration and coordination between these two complex organizational elements, maintenance and supply, largely determines repair readiness and the success of the units' resource management effort.

D. INTERMEDIATE MAINTENANCE

Intermediate maintenance is directed through a basic framework of authority and functional maintenance/supply interrelationships established by the NAMP standard organization.

1. Organization

Repair at the I level is accomplished by the Aircraft Intermediate Maintenance Department (AIMD) both afloat and ashore. The organizational structures presented in Figures III-1 and III-2 illustrate the management, staff, and production relationships developed to materially aid in the achievement of capability goals. Basic span of control, functional alignment, and homogeneity/division of work assignments are established through the standard organization. As shown, the basic framework structures management authority/responsibility, establishes quality assurance/analysis, administration, and the manpower, personnel, and training positions as staff functions, and identifies primary production divisions.

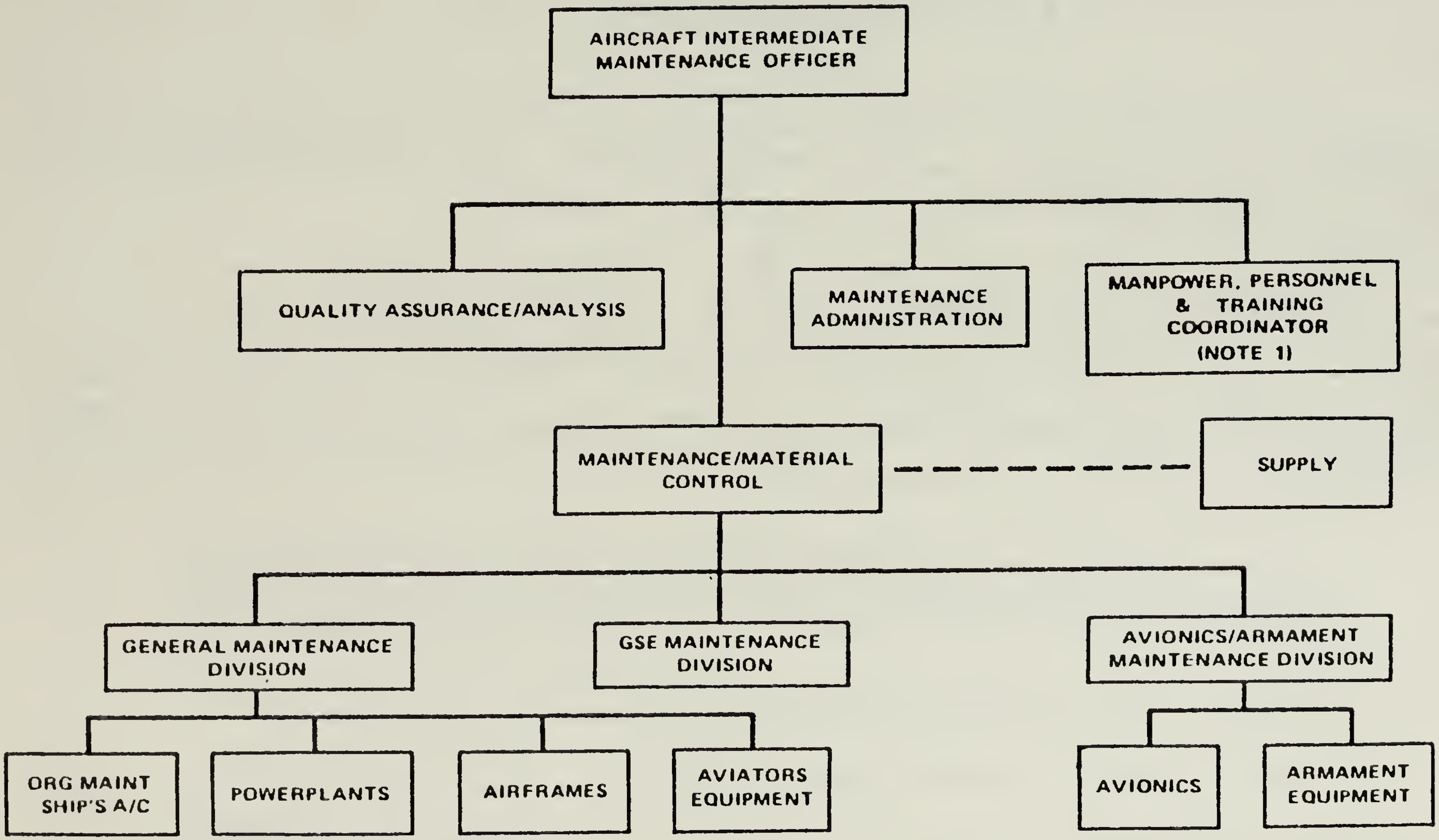
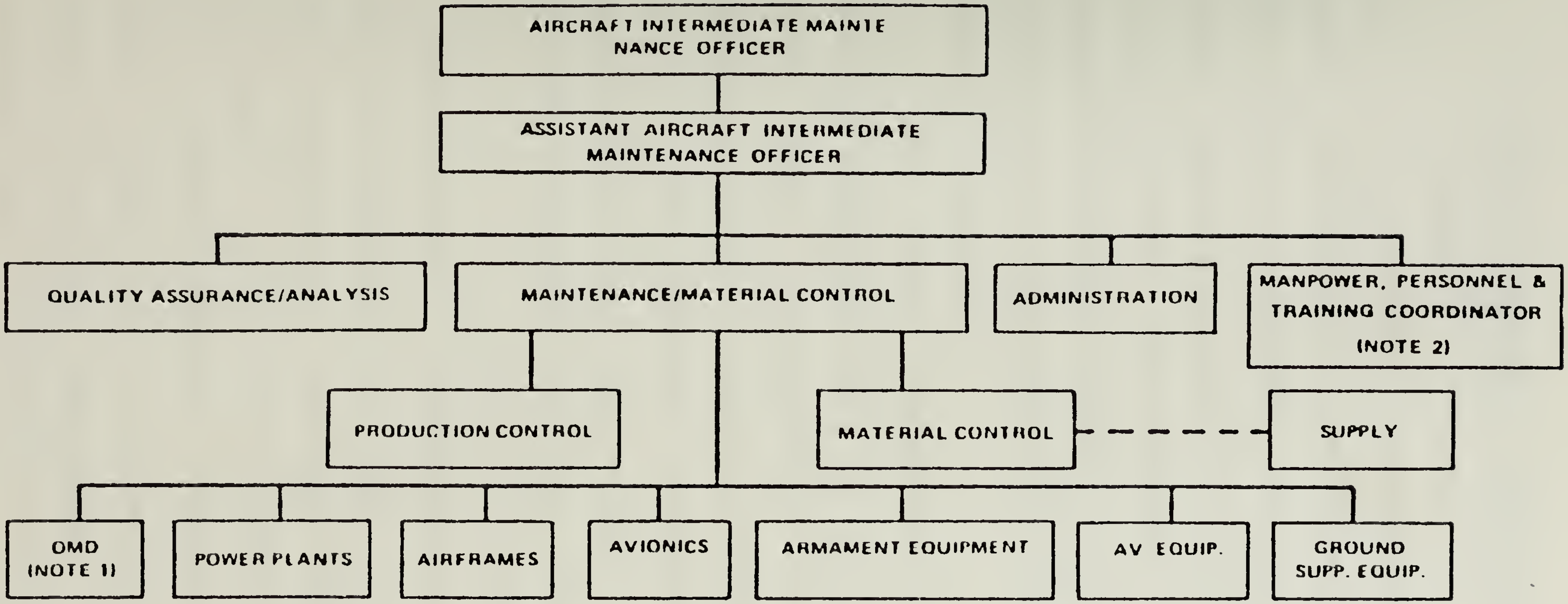


Figure III-1. Intermediate Level Maintenance Department (Afloat) [Ref. 17: p. 1-2-4]



BREAKDOWNS BEYOND THE BASIC DIVISIONS ARE NOT ILLUSTRATED BECAUSE OF THE GREAT VARIETY OF BRANCHES POSSIBLE. ACTIVITIES WILL BE REQUIRED TO ESTABLISH THE NECESSARY BRANCHES IN ACCORDANCE WITH THEIR INDIVIDUAL REQUIREMENTS. APPENDIX "F" (STANDARD WORK CENTER CODES WILL BE USED AS A GUIDE TO ESTABLISH BRANCHES/WORK CENTERS WITHIN THE RESPECTIVE DIVISIONS. THE FOLLOWING GUIDELINES SHALL BE USED AS A BASIS

(A) BRANCHES SHOULD BE ESTABLISHED ONLY WHEN MORE THAN ONE WORK CENTER IS INVOLVED. I.E., JET ENGINE BRANCH WITH WORK CENTERS FOR J-79 ENGINE AND J-52 ENGINE.

(B) WORK CENTERS SHOULD BE ESTABLISHED ONLY WHEN A MINIMUM OF THREE MEN PLUS A SUPERVISOR ARE REQUIRED TO OPERATE A SPECIFIC FUNCTIONAL AREA.

NOTE 1 WHEN SPECIFIC AUTHORITY HAS BEEN GRANTED TO COMBINE THE OMD AND IMA AN ORGANIZATIONAL MAINTENANCE DIVISION WILL BE ESTABLISHED.

NOTE 2 FOR AIMD's NOT LARGE ENOUGH TO RATE THE E-9 BILLET ASSOCIATED WITH THIS FUNCTION, AND IN THOSE CASES WHERE FULL E-9 AND E-8 MANNING IS NOT AVAILABLE, THIS SEPARATE ORGANIZATIONAL POSITION IS NOT REQUIRED.

Figure III-2. Intermediate Level Maintenance Department (Ashore) [Ref. 17: p. 1-2-3]

2. Maintenance/Supply Interrelationships

In addition to the personnel, facilities, and equipment planning, organization, and administration responsibilities normally associated with Department Head assignments, the AIMD officer is responsible for "continuously and progressively" analyzing the mission accomplishment/capabilities of the department. This strategic responsibility emphasizing maintenance/material planning establishes the direct maintenance/supply interrelationship fundamental to repair capability development.

The AIMD officer is supported in his operational and strategic responsibilities by the Maintenance/Material Control Officer (MMCO). As depicted in Figure III-2, the MMCO is responsible for the overall productive effort and material support of the department. He maintains "...liaison with supported activities and the local supply department to ensure material requirements and work load are compatible..." [Ref. 17: p. 2-6-1] and establishes procedures to monitor and coordinate material requirements planning and repair capability. Specific requirements for parts and material within the AIMD are coordinated with the Supply Support Center (SSC) through the Material Control Center (ashore) and the material section of the Maintenance/Material Control office (afloat). Material Control Centers (MCC's) are responsible for the proper forwarding of material requirements, expeditious routing of received parts and materials, control of parts/material

requistions, and the coordination of material ordering, receipt, and delivery. MCC's are functional entities within the maintenance organization serving as a single point of contact with the supply organization's Supply Support Center (SSC).

The Supply Support Center (SSC) is responsible for providing effective supply support to the AIMD. As a functional element at the Aviation Stores division (S-6) level, Figure III-3, the SSC serves as the single point of contact within the Supply department for maintenance activities requiring direct support. The center is divided into two sections. The Supply Response Section (SRS) maintains responsibility for material requests and material delivery. The Component Control Section (CCS) manages repairables stored in Local Repair Cycle Asset (LRCA) storage areas, undergoing repair in the AIMD, awaiting parts (AWP), or in process for shipment to a depot repair facility (see Figure III-4).

E. MAINTENANCE DATA SYSTEM

The Maintenance Data System (MDS) was developed as an integral part of the Navy Maintenance and Material Management (3-M) system. It was incorporated into the NAMP in 1965 in response to a recognized requirement for definitive operational, maintenance, and logistic support information. The system standardizes data collection, coding, and processing procedures. Through an "evolved" system of information reports,

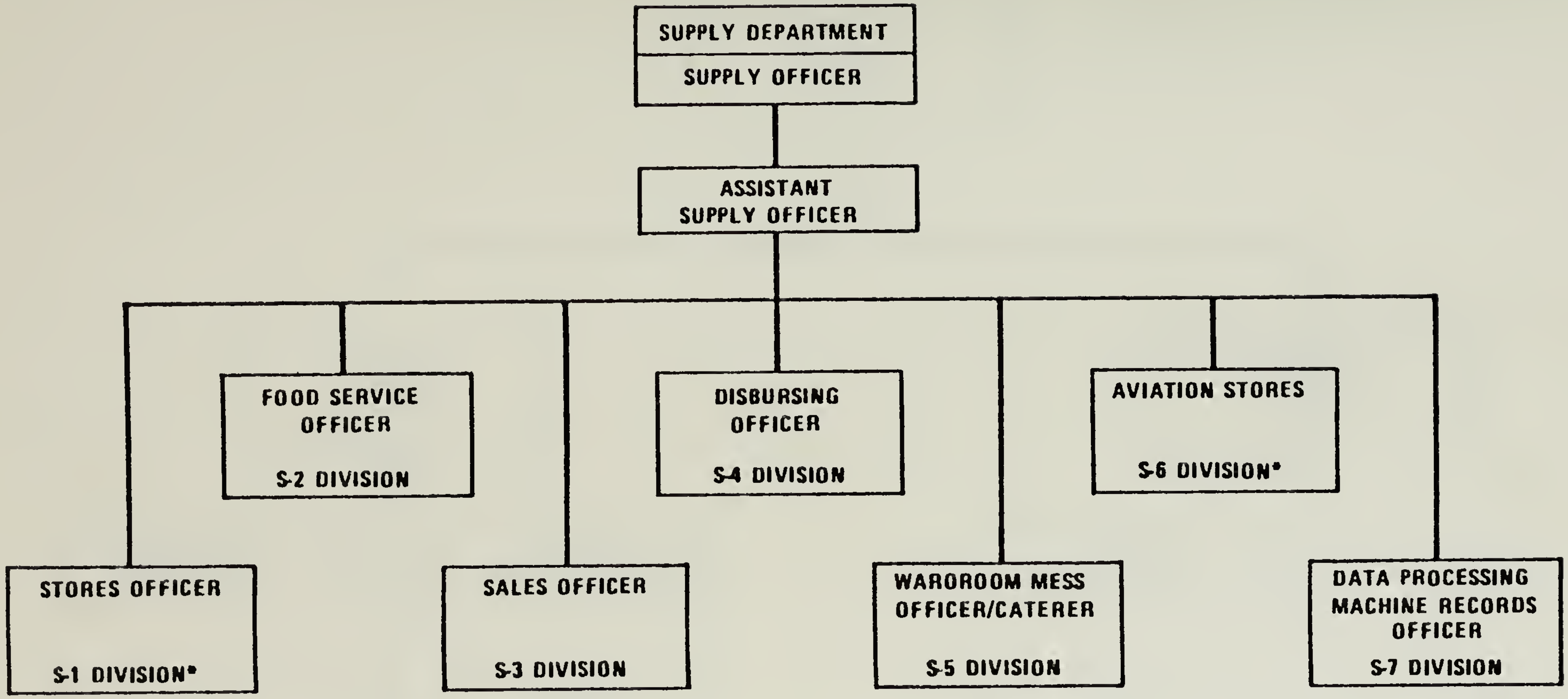


Figure III-3. Supply Department Organization (Afloat) [Ref. 17: p. 4-1-6]

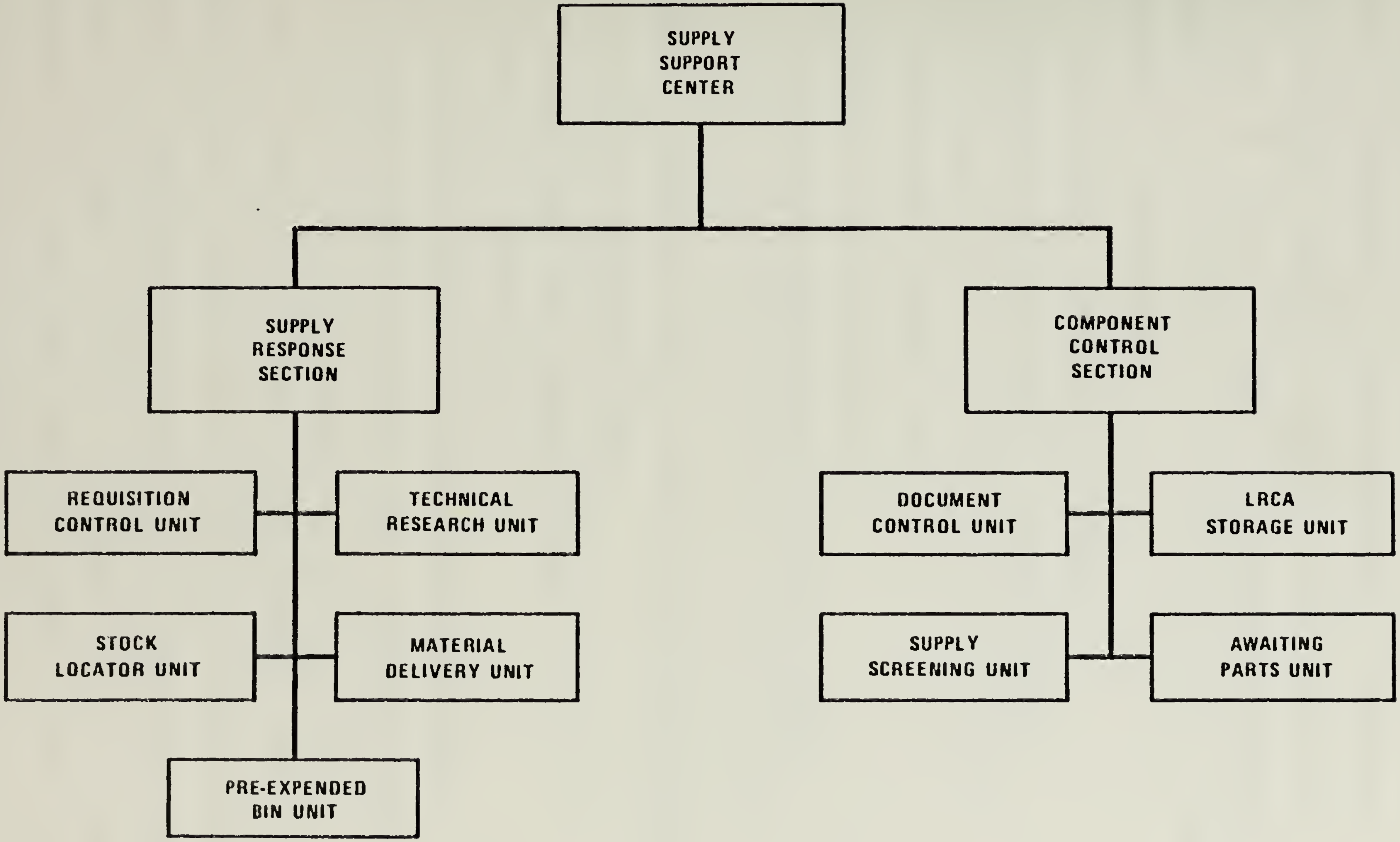


Figure III-4. Supply Support Center Organization [Ref. 17: p. 4-1-7]

it provides historical, trend, and statistical data to all levels of management. MDS is designed to facilitate "... the collection, analysis, and use of pertinent data..." [Ref. 16: p. 1-1-1] in order to effectively improve material readiness. It provides for the documentation of data relative to the following:

* Maintenance personnel utilization
* Equipment maintainability and reliability
* Equipment mission capability and utilization
* Maintenance material usage
* Material non-availability
* Maintenance and material processing times
* Weapon system and maintenance material costing

Elements of MDS are shown in Figure III-5 and include:

* Man-hour Accounting (MHA)
* Maintenance Data Reporting (MDR)
* Material Reporting (MR)
* Subsystem Capability Impact Reporting (SCIR)
* Ground Support Equipment (GSE) inventory reporting
* Training Device Utilization Reporting (TDUR)

MDS is designed so that each individual, during the performance of a maintenance or material requisitioning task, converts a narrative description of the task into codes and enters the coded information on standard forms or source documents. The principal source document is the Visual Information Display System/Maintenance Action Form (VIDS/MAF)

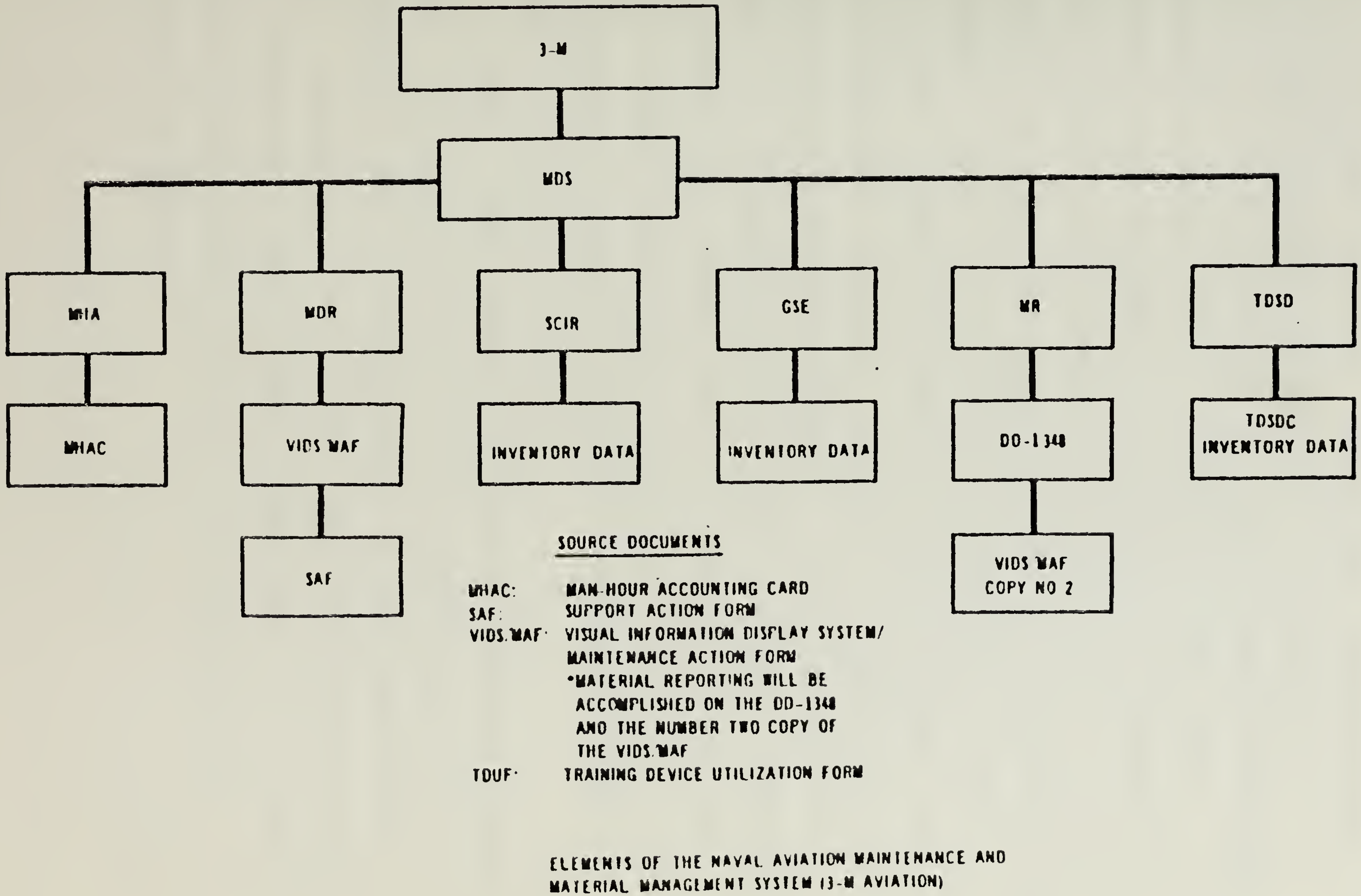


Figure III-5. Elements of the Naval Aviation Maintenance and Material Management System (Aviation 3-M) [Ref. 17: p. 6-1-2]

(Figure III-6) which provides for the coded documentation of equipment, system, component, malfunction, required parts, and expended man-hours data elements. Information is recorded on various copies of the 5-part document during the intermediate repair cycle as depicted in Figure III-7. Completed source documents are collected and transmitted to a data services facility where the information is converted to machine records. The machine records are subsequently used to produce periodic and on-demand, standardized, summary data reports designed to provide supervisors/managers with the informational assistance necessary to support analyses of maintenance and supply problems. Following local processing, the information on the machine records is forwarded to a central data services facility which aggregates the data by weapon/support system in support of the informational requirements of aircraft controlling custodians, program managers, and technical bureaus.

In general, MDS information flows through three related cycles: (1) the local cycle, at the organizational and intermediate levels of maintenance; (2) the local-central cycle, between the local activity (ship or station) and the Navy Maintenance Support Office (NAMSO); and (3) the central external cycle, between NAMSO and the various systems commands and offices.

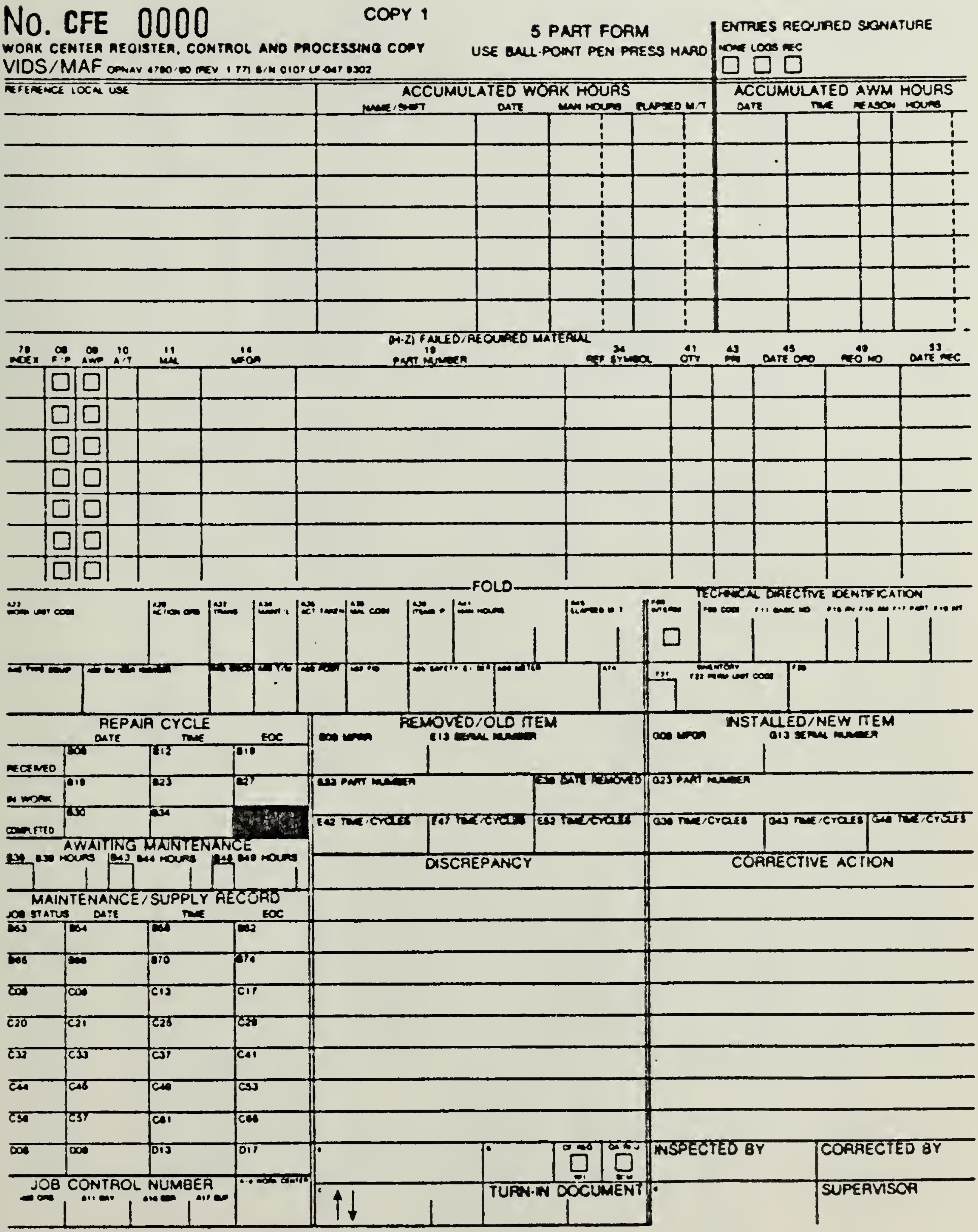


Figure III-6. Visual Information Display System/Maintenance Action Form [Ref. 17: p. 6-4-7a]

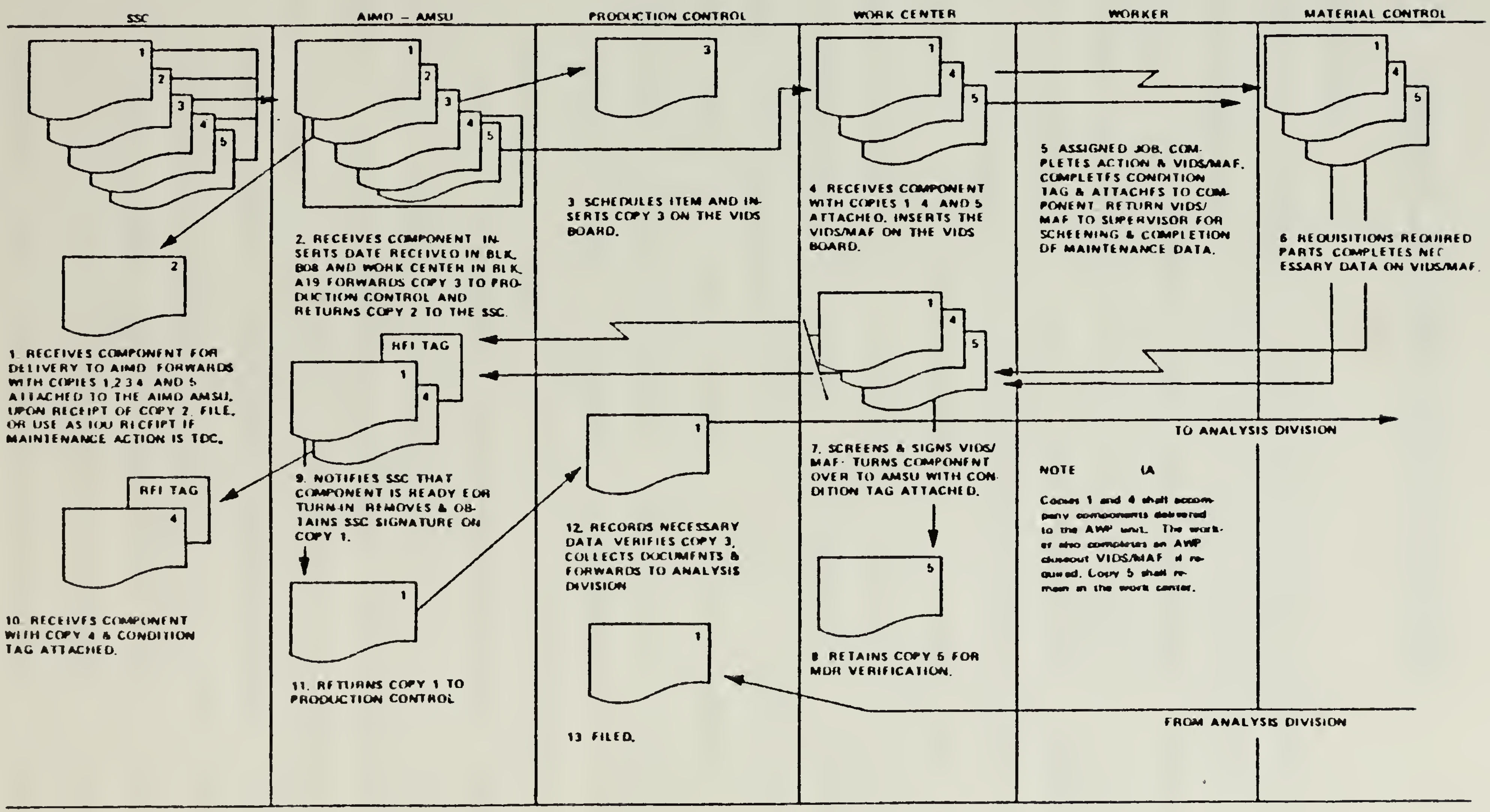


Figure III-7. VIDS/MAF Document Flow [Ref. 17: p. 3-7-11]

IV. PLANNING "I" LEVEL REPAIR CAPABILITY

A. INTRODUCTION

The NAMP is a complexly integrated program through which CNO mission objectives for naval aviation are translated into "governing" support policies and procedures. Program logistic support functions, while distinguishable in the assignment of specific "I" level responsibilities, become obscured in the complex planning decisions that affect readiness. Clearly it is not now possible, as it might have been at some time in the past, to accurately determine whether a particular degradation in an IMA's performance is directly attributable to either maintenance or supply. Plans for maintenance, plans for supply support, and maintenance/supply functional interrelationships are much too complex for that. Readiness has thus become an integrated planning problem. Solutions to readiness problems are dependent on the identification of critical performance measures and a determination of resource requirements based on an analysis of the complex interrelationships between those measures. This chapter continues to provide background information relevant to the readiness/resource planning problem. It addresses the specific aviation planning responsibilities assigned to various Navy offices, discusses existing and planning information systems developed in support of those planned responsibilities, and outlines projected information system shortfalls.

B. STRATEGIC/TACTICAL PLANNING

As stated at the conclusion of Chapter II, strategic "capability" is developed in response to mission requirements imposed by an environmentally sensitive "operational concept". Strategic planning is not an objective task. Instead, it is a task closely related to the "pattern of decisions" involved in the business community's development of a corporate strategy. Corporate strategy "...(1) determines, shapes, and reveals...objectives, purposes, or goals; (2) produces principal policies and plans for achieving those goals; and (3) defines the business..." [Ref. 18: p. 93]. In much the same way, strategic planning in the naval aviation community involves attempts to deal with the operational environment, changes in mission/technology/etc., under conditions of uncertainty. Strategic planning represents a "corporate" effort to create an artificial environment within which the "technical core" can perform with "certainty".

Readiness, on the other hand, is a tactical concept. As such, it serves the annual programming and budgeting process. Tactical planning is principally dependent on information accuracy and reliable measurement systems. It involves specific tasks associated with the development of procedures, budgets, and schedules necessary to accomplish short-term objectives in support of strategic goals.

C. NAVAL AVIATION "PLANNING"

NAMP program direction results from the coordinated strategic and tactical planning efforts of several Navy offices.

1. OPNAV (force strategic)

Force "capability" planning is accomplished by the OPNAV Long Range Planning Group (OP-00X). Established in 1980, the group assists CNO in the development of a long-range "operational concept". Four strategic planners, within the OP-00X structure, assist in the conduct of projected operational environment studies, analyze navy/civilian technological initiatives, and coordinate the research and development planning functions assigned to other CNO staff offices in the principal areas of technology, politico-military, resources, and programs. While "...most existing planning focuses on specific action programs designed to produce ... precisely defined results...", "...the long range planning group will usually describe preferred outcomes for the whole navy" [Ref. 19: p. 64].

2. OPNAV/NAVAIR (mission strategic)

Mission strategic planning specifically related to naval aviation is accomplished by OPNAV and NAVAIR through preparation of the 20-year Naval Aviation Plan (NAP). Signed jointly by the Deputy Chief of Naval Operations (Air Warfare), (DCNO AIR, OP-05), and the Commander, Naval Air Systems Command, annual development of the plan is coordinated through the

Aviation Plans and Requirements Division (OP-50) of OPNAV and the office of the Deputy Commander for Plans and Programs (AIR-01) of NAVAIR. The NAP reflects strategic policy in providing mid-range planning guidance relevant to "...current (five-year defense plan) FYDP approved force levels, FYDP procurements/modification plans, and 15 year extended mission projections of those plans" [Ref. 20: p.]]. The NAP directs tactical planning. It includes "...objectives and planning data required to develop, procure, and maintain an aviation force structure responsive to current and projected naval roles and threats..." [Ref. 20: p. 2].

3. CNM/NAVAIR (tactical)

The task of "budgeting" material support for the NAP falls essentially on the project offices of the Chief of Naval Material (CNM) and the plans and programs divisions of the Commander, Naval Air Systems Command (NAVAIR). It is an extremely difficult task. NAP objectives must be reduced to program elements, alternatives must be identified, planning data must be developed for each alternative, alternatives must be analyzed in terms of support requirements, and support requirements estimates must be translated into justifiable budget figures in preparation for an on-going process of program element/budget review. The tactical planning process involves consolidation of program elements into an annually budgeted support "package".

4. AIMSO (strategic/tactical interface)

As a field activity of the OPNAV NAMP policy office, AIMSO serves as the methods link between the "capability" (strategic) planners at OPNAV and the "readiness/resource" (tactical) planners at NAVAIR for intermediate maintenance. A principal responsibility of the office is development of the "I" level programs and procedures necessary to achieve readiness/resource goals. This responsibility underscores the present-day Congressional/DOD emphasis on measuring the relationships between resources applied and missions accomplished, utilizing performance measurements in determining program/readiness improvement requirements, and developing capability plans on the basis of evaluated readiness/resource interrelationships.

D. PLANNING SUPPORT SYSTEMS DEVELOPMENT

Naval aviation planning is supported by the aviation 3-M system. As discussed earlier, incorporation of the MDS portion of the aviation 3-M system into the NAMP was the significant first step in what has evolved into an effectively integrated and standardized operational, maintenance, and logistics source data collection system. Numerous program modifications demonstrate that "...the accumulation of definitive information, and the eventual distribution of (that) information throughout all levels of the naval aviation community has (been) a paramount effort in naval aviation maintenance since the

1960's" [Ref. 21: p. 9]. That notwithstanding, the informational demands of MDS system "users" are not being met. The manual documentation and source document review process is error-prone and time consuming. Additionally, the capability of the 3-M system is increasingly limited by batch processing procedures and electronic accounting machine (EAM) technology. These limitations have resulted in man-machine interface problems, a general lack of confidence in machine reports, and minimal utilization of data analysts in their primary area of responsibility. While it was recognized shortly after implementation that "...the information required by... management on which to base decisions (was being) rendered stagnant by outmoded data systems..." [Ref. 21: p. 17], budget limitations stonewalled the transition to "newer" technology for years.

In the late 1960's, informational demands from operational commanders concerned with aircraft readiness figures resulted in several significant studies. The Carrier Aircraft Maintenance Support Improvement (CAMSI) project was commissioned in 1970 by the CNO to identify priority actions to improve carrier aircraft readiness. The project concluded that improved readiness could be achieved through increased efficiency in the management of maintenance and support functions, and that the most practical and cost effective means of attaining essential levels of efficiency would be through improved use of automated data processing equipment.

In 1972, a follow-on project sponsored jointly by the Naval Air Systems Command and the Naval Supply Systems Command was adopted. Termed Shipboard Aviation Command Management Information System (SACOMIS), the project provided prototypes for computerized 3-M MDS information systems. SACOMIS was expanded to include air stations, air groups, and all aviation ships and became the Naval Aviation Logistics Command Management Information System (NALCOMIS) in 1974 [Ref. 22: p. 46].

Similar informational demands by NAVAIR program divisions tasked with integrated logistic support for weapons systems resulted in simultaneous (early 1970) studies in data base management systems. Those studies resulted in the development of a NAVAIR corporate data base called the Naval Aviation Logistics Data Analysis System (NALDA). NALDA was commissioned in May of 1976 and design certified in December, 1979.

E. INFORMATION SYSTEM OBJECTIVES

Under the sponsorship of OPNAV and the direction of NAVAIR, a complex, computerized NAMP management information system (MIS) is nearing the implementation phase of its developmental process. Planned for incorporation at the organizational and intermediate maintenance/supply levels, the NALCOMIS portion of this integrated information system is "...essentially a logical improvement to the NAMP...(resulting) from technological improvements...in the automated data

processing field" [Ref. 22: p. 45]. The principal purpose of NALCOMIS is to "...improve operational readiness... through improvements, via automation, of aircraft maintenance and supply management effectiveness" [Ref. 23: p. 2-1]. In addition to VIDS/MAF automation, the system provides support programs designed for each independent functional process (OMA/IMA/SSC) and distributed data base design. It will do much to correct existing 3-M system problems discussed earlier.

The second major portion of this complex support system is NALDA which provides, as its principal objective, a significantly improved logistics data analysis capability to CNM, NAVAIR, and other activities tasked with support planning (logistic) responsibilities. NALDA receives up-line transfers of maintenance, supply, operations, material, configuration, safety, and other logistics data from existing data collection systems. In addition to the data provided by the NAMP Maintenance Data System (MDS), major aviation support offices including the Aviation Supply Office (ASO), Naval Air Rework Facilities (NARFS), the Naval Safety Center, and the Naval Air Technical Services Facility (NATSF) contribute to the data base. Data, stored in a central integrated data bank, is structured for processing by NAVAIR application programs in support of NAVAIR tactical planning, source level data analysis, and interactive query requirements.

F. PROJECTED INFORMATION SYSTEM SHORTFALLS

In 1970, Robert N. Anthony, then Assistant Secretary of Defense (Comptroller), advocated development of an integrated data base system from which an infinite number of management program applications could be made. He contended that "... the plain fact is that the system designer cannot find out what management needs to know. We discovered long ago that it is futile to ask managers what data they need; they simply cannot foresee the uses that might be made" [Ref. 24: p. 37]. Both NALCOMIS and NALDA support Anthony's view. Focusing primarily on information collection, both programs provide structure to the automation and management of input. It is agreed that real-time access to accurate, integrated information can improve the useability of output. It is argued, however, that expanded information processing and task management capabilities will do little to improve the strategic, tactical, and operational plans and decisions associated with readiness/resource management unless they are directed through a structured decision framework.

Walter Kennevan states that management information systems (MIS's) support "...the planning, control, and organizational functions of an organizaiton by furnishing uniform information in the proper time-frame to assist the decision-making process" [Ref. 25: p. 302]. Expanding on Kennevan's definition, it is important to recognize MIS characteristics detailed or alluded to in most definitions. An MIS, particularly one

that is automated,

* Provides managers with complete, accurate, and timely data.

* Structures and quantifies historical data.

* Provides for historical/trend analysis.

* Reports to each management level necessary degrees of detail in an adapted form which minimizes the necessity for further analysis.

NALCOMIS and NALDA are essential components of a "state of the art" readiness/resource MIS. In conjunction with the 3-M system, they reflect the MIS characteristics presented. Nevertheless, two significant shortfalls will persist following implementation of those existing programs that exist today at the heart of the readiness-to-resources planning problem. They do not (1) measure relationships between resources applied and missions accomplished in (2) a framework that facilitates tactical decision-making. As those measures and the structure are undefined, so is the direction of information gathering undefined, measurements of the relationships between readiness and resources uncertain, and the justifiability of tactical planning requirements vulnerable to challenge.

V. DECISION THEORY AND SUPPORT SYSTEMS

A. INTRODUCTION

The strategic/tactical planning process, through which readiness is assessed, resource requirements are justified, and capability is planned, depends principally on the effectiveness of a decision support system which evaluates information system elements in terms of decision variables considered together. Information systems by themselves do not support the "What if?" analyses essential to the planning process. The absence of a decision support system at the various management levels responsible for intermediate repair precludes reliable accomplishment of "readiness" and "resource utilization" NAMP objectives. This chapter examines decision theory and essential elements of decision support systems.

B. PERSPECTIVE

Decisions involve choices among alternatives. They are the final result of an analysis of answers to repeated "What if?" questions. Despite the dramatic progress that has been made in integrating all of the various functional elements associated with the collection of 3-M source data and the information processing/formatting promise offered by NALCOMIS and NALDA, little progress has been made toward putting "current information" to use in the readiness/resource decision process.

The 3-M system is an efficient, complexly integrated MIS. But, as McCosh and Morton point out in their book entitled Management Decision Support Systems, MIS's "...(have) had little significant impact on management. The kinds of decisions and the ways in which they are made have been very little affected..." by the availability of information. While it is certainly true that information is fundamental to the development of intelligent alternatives, MIS's essentially serve "What is?" not "What if?" needs. The "up-line information transfer" provision built into 3-M assumes that there is another formal planning support structure which provides for the integration of strategic, tactical, and operational functions between weapons systems support programs when, in fact, there is not. The absence of such a "decision" support system within the tactical planning and operational control framework of intermediate level support is critical and leads in almost every area to suboptimization along program lines. "AIMD managers currently do not have the capability to relate their actions to the readiness of the aircraft they support" [Ref. 26: p. 2-2]. Without that readiness to resources link at the operational level, there can be little doubt that tactical planning decisions are being made in virtual isolation and that project/program managers must also fight the suboptimization threat. What is needed "...is a system that focuses attention on specific goals and objectives, measures performance accurately and

fairly against those goals and objectives, and provides ...information in forms useful to...(management)" [Ref. 27: p. ii].

C. DECISION THEORY

Numerous models of decision theory have been developed since the 1960's. In one of the earliest, Herbert Simon advances the theory that the decision process is a function of three elements: (1) searching the environment for conditions calling for decision (intelligence); (2) inventing, developing, and analyzing possible courses of action (design); and (3) selecting a particular course of action from those available (choice). In developing that concept he concludes that, on the basis of those three steps, decisions may be considered as either programmable (all three steps can be automated) or non-programmable (at least one step cannot be automated).

Anthony's decision model approaches the problem from a different perspective. He divides decision making into: (1) the process of assuring that specific tasks are carried out effectively and efficiently (operational control); (2) the process of assuring that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives (tactical control); and (3) the process of deciding on the objectives of the organization (strategic planning) [Ref. 28: p. 16].

Anthony's study led, in the mid-1970's, to the generally accepted view, among information system researchers, that three levels of information systems are required in support of the three levels of planning and control. These are illustrated in Figure V-1. In developing those systems, researchers contend that the entire management structure is supported by a transaction processing system not concerned with providing information for management in and of itself. The transaction processing system merely establishes and maintains the data base through routine day-to-day paperwork processing.

The assumption that information exists solely to support decision-making forms the basis for decision support system research by Keene and Morton. They have developed Simon's concept of programmability by defining three decision formats: (1) all steps automated (structured); (2) one but not all steps automated (semi-structured); and, (3) no steps automated (unstructured). Those formats were applied to Anthony's decision model. The result presented in Figure V-2 is a matrix structure which directs management toward the structuring of increasingly complex decisions and the potential advantages associated with extending the decision makers' planning range.

Decision theorists suggest that there is a possibility of structuring "...human cognitive processes and their interaction with human emotions, attitudes, and values" [Ref. 30: p. 31].

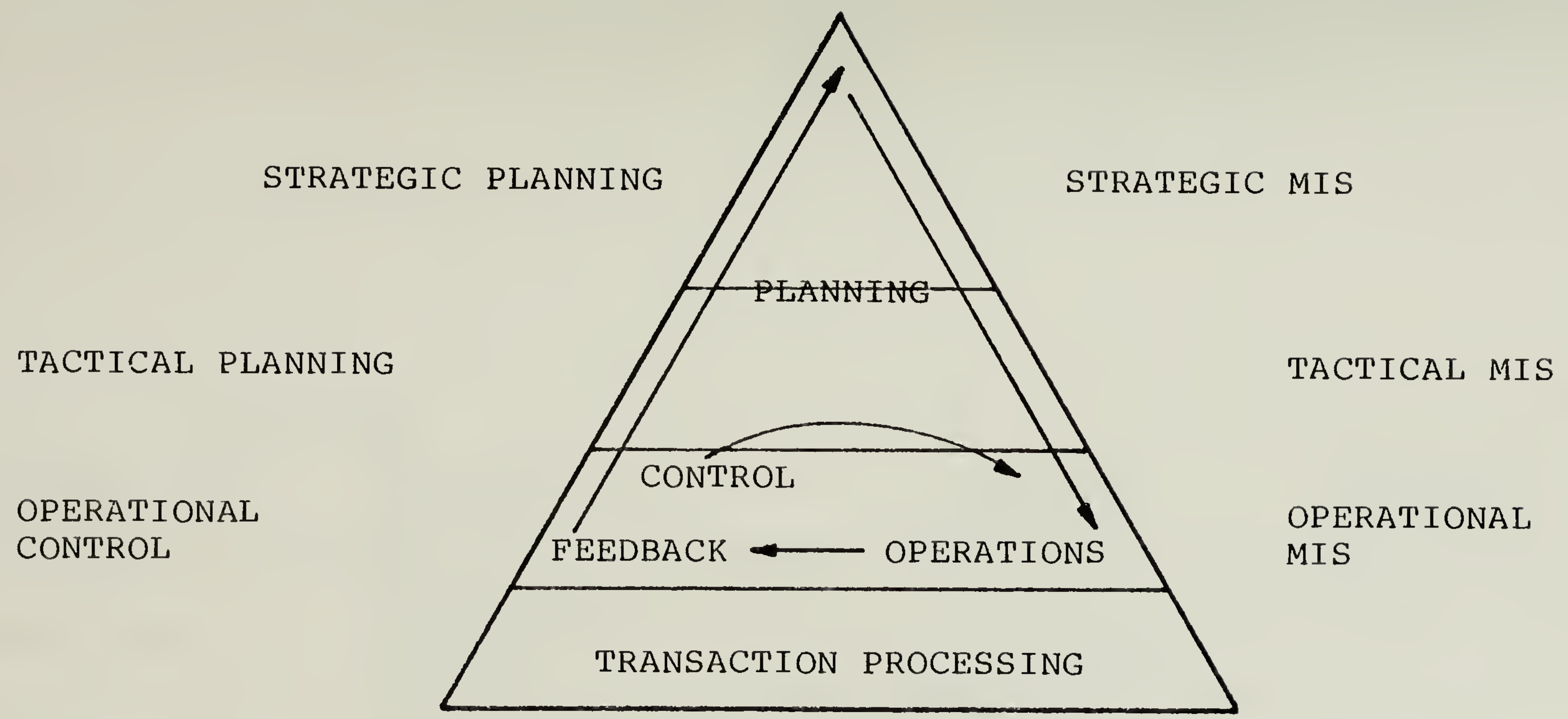


Figure V-1. Functions of Planning, Information and Control by Different Levels of Management [Ref. 29:428]

TYPE OF DECISION / FUNCTION	OPERATIONAL CONTROL	TACTICAL PLANNING	STRATEGIC PLANNING
STRUCTURED	TRANSPORTATION/ ASSIGNMENT MODELS	PROGRAM CONTROL (PERT)	FORCE ALLOCATION
SEMI-STRUCTURED	INVENTORY CONTROL PRODUCTION PLANNING	BUDGETING	FORCE PLANNING
UNSTRUCTURED	WEAPONS DESIGN IMPROVEMENT	PROGRAM REQUIREMENTS	CAPABILITY PLANNING R & D

Figure V-2. Keene-Morton Decision Classification [Ref. 29:423]

Experience to date supports that possibility. While many believe "ill-defined" [Ref. 31: p. 148] or "ill-formed" [Ref. 32: p. 268] problems will always be present, management science and operational research "models" have in recent years provided impressive structure to decisions previously considered non-programmable.

The 3-M system serves decision makers at the transaction processing system level. NALCOMIS, through the automation of existing manual data collection procedures and selected management tasks will attempt to improve operational control at the organizational and intermediate levels. NALDA serves as a structured, integrated data base. What is missing is a system that puts all of that information to use within an appropriate, objective-oriented framework. Clearly systems knowledge has progressed to the point that emphasis can and should now be directed toward "...entirely new kinds of systems that dynamically involve the manager's judgment and support him with analysis, models, and flexible access to relevant information" [Ref. 33: p. 4].

D. DECISION SUPPORT FRAMEWORK

The continual recycling of information throughout the organizational structure, Figure V-1, while theoretical, establishes a basic decision support framework from which two significant conclusions can be drawn. First, an integrated approach to the readiness/resource "capability"

problem requires that quantitative measures be developed which evaluate deviations from mission-oriented performance objectives. Second, a hierarchical framework must be developed which provides for the partitioning of strategic objectives down to the operational control level and the structuring of performance information up to the strategic planning level. The following two chapters develop an approach to the NAVAIR readiness/resource planning problem. Chapter VI examines the development of "I" level performance measures. Chapter VII integrates those performance measures into a mission-oriented decision support framework.

VI. "I" LEVEL PERFORMANCE MEASURES

A. INTRODUCTION

Achievement of the readiness standards established by the CNO is the principal NAMP objective. This objective provides the mission-oriented focus essential to the integration of tactical planning (CNM/NAVAIR) and operational control (supply/AIMD) logistics functions. Appropriately, performance with respect to the NAMP objective is measured at the point at which it is most important, the material conditon of the aircraft supported. This chapter examines "I" level performance measures and the extent to which current/planned measures evaluate deviations from mission-oriented performance objectives defined in terms of aircraft mission capability.

B. MISSION CAPABILITY

Enclosure (4) to OPNAV instruction 5442.4H establishes CNO's mission capable (MC) goals by type/model/series (T/M/S) aircraft and unit operational category. The goals, the "objective" readiness standards of the NAMP, are defined in terms of the percentage of time an aircraft is considered to be mission capable, i.e. the material condition of the aircraft is such that it can perform at least one and potentially all of its assigned missions. Determination of specific aircraft/unit goals is based on a Five Year Defense Plan (FYDP)

percentage projection of planned numbers of each aircraft T/M/S compared to primary aircraft inventory (PAI) totals. The PAI percentage is evaluated in terms of the history of each program, the importance of each program, and the funding available. While the overall aircraft mission capable goal is 70 percent, individual program goals and consequently support program goals vary. For example, enclosure (4), reprinted in part in Figure VI-1, establishes the goal of a "non-deployable" AIMD (category 4) tasked with providing support to the EA-3B aircraft as one of providing sufficient support to ensure a 48 percent aircraft mission capability rate.

The basic instruction provides policy guidance for material conditon reporting. The reporting system presents a coding procedure which relates particular aircraft systems and subsystems to specific aircraft missions. Equipment Operational Capability (EOC) codes identify the systems required to perform certain missions and, through matrix construction, the impact of failure of that system on the aircraft's mission capability. Figure VI-2 is an example of the mission-essential subsystem matrix. In that example, failure of equipment 9 would result in a complete loss of mission capability, the aircraft would be unable to perform even one mission, for the amount of time equipment 9 is inoperative.

I. All Categories. A combination of catagories II, III and IV listed below.

II. Deployed Units. All units assigned outside the continental limits of the United States except station OMD/AIMD and other activities that do not provide direct support to fleet operations.

III. Workup/Ready Duty Units. Units within ninety (90) days of an extended deployment, including formal detachments with a PUC and 3-M organization code assigned.

IV. Other Units. Deployable units not in categories II or III, readiness units such as fleet readiness squadrons, and other permanent units which include all "non-deployable" units, station OMD, AIMD, etc.

TYPE/MODEL SERIES	MISSION CAPABLE GOALS (PERCENT)			
	I	II	III	IV
EA-3B	53	58	53	48
KA-3B	72	77	72	67
ERA-3B	53	58	53	48
TA-3B	80	85	80	70
A-4E	65	70	65	60
A-4F	62	67	62	57
EA-4F	65	70	65	55
TA-4F	72	77	72	67
TA-4J	65	70	65	55
A-4M	68	73	68	58
OA-4M	73	78	73	68
EA-6A	58	63	58	53
EA-6B	70	75	70	65
KA-6D	69	74	69	64
A-6E	65	70	65	60
A-7A	33	38	33	28
A-7B	33	38	33	28
A-7C	50	55	50	45
TA-7C	50	55	50	45
A-7E	70	75	70	65
C-1A	64	69	64	59
C-2A	57	62	57	52

Figure VI-1. Mission Capable Goals by Type/Model/Series Aircraft and Unit Operational Category [Ref. 34: p. 1]

EOC ALPHA DESIGNATOR	MISSION ESSENTIAL EQUIPMENT	OPC MISSION	FMC MISSION	PMC MISSION	PMC MISSION	PMC MISSION	PMC MISSION	PMC MISSION SAFELY FLYABLE
B	EQUIPMENT 1	X						
C	EQUIPMENT 2	X	X					
C	EQUIPMENT 3 (T/A MODE)	X	X					
D	EQUIPMENT 4 (2 of 2 required)	X	X	X				
D	EQUIPMENT 5	X	X	X				
J	EQUIPMENT 6	X	X	X	X			
J	EQUIPMENT 7 (NOTE 1)	X		X	X			
K	EQUIPMENT 3 (T/F MODE)	X	X	X	X	X		
L	EQUIPMENT 8	X	X	X	X	X	X	
Z	EQUIPMENT 9	X	X	X	X	X	X	X
Z	ENGINE INSPECTION	X	X	X	X	X	X	X

Figure VI-2. Mission Essential Subsystem Matrix [Ref. 35: p. 4]

C. PERFORMANCE PERSPECTIVE

Determining performance with respect to mission capability goals is relatively simple at the organizational maintenance level. Subsystem Capability Impact Reporting (SCIR), a 3-M system subprogram, documents, through the use of EOC codes, the amount of time a squadron aircraft is "not mission capable" (NMC) as a result of either required maintenance or supply shortage.

At the intermediate level of maintenance aircraft components lose their SCIR identity. This is as it should be since the defective components have entered the supply system, been replaced in the aircraft by an operational spare, and no longer have a direct, adverse impact on an aircraft's mission capability. The problem is, however, that, as a result of the loss of SCIR identity, repair performance at the intermediate level is difficult to evaluate with respect to mission capability goals.

Mission-oriented "I" level performance measures are fundamental to the NAVAIR resource program planning/justification task. NAVAIR planners responsible for "I" level automatic test equipment support for example must be able to determine the extent to which existing test "benches" provide support before they can be expected to evaluate the "What if?" impact of program modifications and justify resulting recommendations.

D. CURRENT PERFORMANCE MEASURES

Briefly discussed, current measures of intermediate level maintainance/supply performance include:

* turnaround time (TAT) - average length of time a component spends in the repair cycle.

* ready-for-issue (RFI) rate - percentage based on the number of components repaired by the AIMD and the number of components inducted for repair.

* beyond the capability of maintenance (BCM) rate - percentage based on the number of components which cannot be repaired by the AIMD and must be forwarded to a depot level repair facility and the number of components inducted for repair.

* "Y" code rate - percentage based on the number of repaired components returned for repair with a "Y" when discovered code (received bad from supply) and the number of components inducted for repair.

* A-799 rate - percentage based on the number of repaired components returned for repair with a "repeat" discrepancy and the number of components inducted for repair.

* fill rate - percentage based on the number of requisitions filled within established timeframes and the number of "valid" requisitions.

* supply response time - average length of time required to respond to requisition demands.

* rotatable pool effectiveness - percentage based on the number of designated "special interest repairable" requisitions filled and the number of designated "special interest repairable" requisitions received.

Current measures do not evaluate deviations from mission-oriented performance objectives. They have little to do with the mission capability of aircraft. As a result, they do not serve the "readiness" assessment interests of NAVAIR "resource" planners. "Current measures...focus primarily on levels of activity" [Ref. 27: p. iii]. They are, at best, diagnostic indices concerned with the efficiency and effectiveness of intermediate organizational elements.

E. AIMD PERFORMANCE MANAGEMENT SYSTEM (APMS)

In 1982, the Aircraft Intermediate Maintenance Support Office (AIMSO) contracted the Logistics Management Institute (LMI) to study AIMD performance measures. The study concluded that "in-use" performance measures did not "... measure relationships between resources applied and missions accomplished" [Ref. 27: p. iii]. The LMI recognized the shared "aviation logistics system goal" of local supply and maintenance activities: "...to achieve and maintain required readiness levels in a cost effective manner for each (type/model/series) aircraft..." [Ref. 27: p. iii]. Consistent with that shared goal, they proposed a comprehensive performance management system which would include the readiness

status of all aircraft, recognize organizational contributions to aircraft readiness, and identity problem areas which adversely impact readiness. The AIMD Performance Management System (APMS) is currently under development at Naval Air Station (NAS) Miramar, California.

The principal features of the APMS include (1) a single readiness-oriented logistics goal; (2) a set of five performance objectives in support of that goal; (3) a structured set of performance and diagnostic indices which measure critical logistics factors in relation to the performance objectives; and (4) a strategy for representing the performance information.

The APMS framework, presented in Figure VI-3, facilitates a description of the system. The "single goal" of the local logistics process is evaluated in the AIMD performance index. Represented mathematically below, the AIMD performance index is derived from the type/model/series (TMS) support indices, the resource management index, the maintenance production cost index, and a performance-based target.

$$API = \frac{(\Sigma\ TMSSI/N)\ (RMI)\ (MPCI)}{APT}$$

where:

TMSSI = type/model/series support index

n = number of t/m/s supported

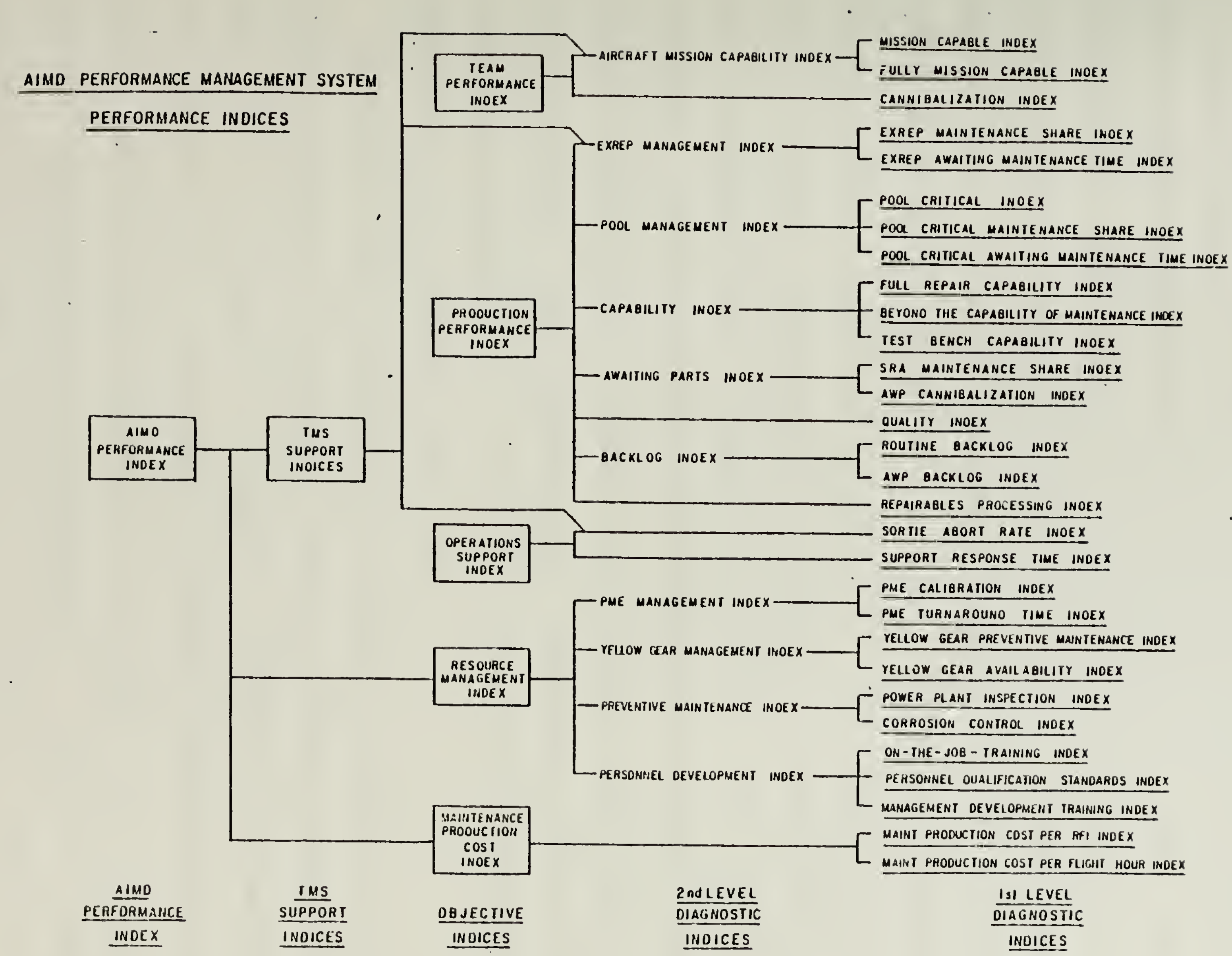


Figure VI-3. AIMD Performance Management System Framework [Ref. 27: p. 2-4]

RMI = resource management index

MPCI = maintenance production cost index

APT = AIMD performance target

At the objective level, 5 indices measure logistics performance in support of the "single goal". The "team performance index" measures performance in relation to the first objective (maximize support through a local logistics team effort). The "production performance index" measures performance in relation to the second objective (minimize the downtime of supported aircraft). The "operations support index" measures performance in relation to the third objective (minimize launch delays and aborts). The "resource management index" measures performance in relation to the fourth objective (to develop and maintain AIMD capabilities and resources). The "maintenance production cost index" measures performance in relation to the final objective (productivity at least total cost).

At each level, indices are linked, by either type/model/series aircraft or functional area, to both aircraft readiness and the resources available. Linking is accomplished through the use of diagnostic indices, many of which currently serve as AIMD performance measures. For example, the "beyond the capability of maintenance index is computed in essentially the same manner as the BCM rate referred to earlier. Under APMS, the index is recognized as a first level diagnostic index which, when combined with the full repair capability

index and the test bench capability index, constitutes a second level diagnostic index referred to as a capability index. As part of the production performance index, then, repair capability is computed and evaluated for each type/ model/series aircraft supported by the AIMD.

Through the hierarchy of performance indices, the effects of logistics support program deficiencies on aircraft "mission capability" rates can be monitored and controlled. Each index, whether at the AIMD performance level or the first level diagnostic level, is computed in the following manner.

$$\text{Performance Index} = \frac{\text{Management Variable Value}}{\text{Performance Target Value}}$$

Each index represents a percentage of the target achieved and provides for performance trend analysis, problem identification, factor comparisons/correlation, and alternative action analysis.

APMS is "readiness oriented". It is an integrated system of performance and diagnostic measures designed to support both the informational and the decision-making requirements of intermediate level logistics managers assigned operational control functions. APMS represents a significant step toward the establishment of a mission link between CNO goals and squadron operations.

The APMS is significant for four reasons. First, it identifies the information elements required (not all required

by APMS are available through the 3-M system) in the development of quantitative measures which evaluate deviations from "mission" performance objectives. Secondly, the system develops an extensive set of performance and diagnostic indices. Thirdly, APMS structures an index-based decision framework through which performance variables may be considered together. Lastly, the indices developed under APMS provide a mission-oriented performance information base upon which a NAVAIR tactical planning, readiness to resources, decision support framework may be constructed.

VII. A FRAMEWORK FOR TACTICAL PLANNING

A. INTRODUCTION

Mission-oriented performance measures are essential to effective resource management at the operational level. They do not, however, provide, through simple aggregation, the information necessary to support resource allocation planning. In organizational systems, objectives are defined in increasingly specific terms from the strategic to the operational level. In the same manner, performance information must be restructured to meet the system needs of tactical planners. This chapter examines the need for a hierarchical decision support framework through which the performance measures discussed in Chapter VI can be structured to serve an integrated control/planning system.

B. GENERAL

Operational control takes place in an established resource environment. At the operational level, it is not a matter of deciding how many test benches are needed but rather how best to schedule components across available test benches. "I" level "control" decision support systems collect information about critical maintenance/supply processes, flows, and functions, apply scheduling algorithms, and present decision "options" in formats developed to facilitate production efficiency decisions. The entire "control"

decision process lends itself to the application of linear analytic problem-solving methods as a result of the single "efficiency" objective and the availability of quantifiable performance measures.

Tactical planning differs significantly from control. It is less constrained in terms of perspective, frequently oriented toward multiple objectives, and necessarily more dependent on subjective judgement. As a result, tactical planning decision support systems, while based on operational information, involve much more than the simple accumulation of "performance" information elements and a wider application of analytic processes. Tactical decision support systems, should "...incorporate multiple objectives, deal with many interacting variables, use aggregate information, and exploit ...judgment within the context of the planning programming and budgeting process" [Ref. 36: p. 2-11].

C. SYSTEMS ANALYSIS TECHNIQUES

As discussed earlier, NAVAIR program planning is supported primarily by a structured, integrated data base of aviation 3-M information, stored in NALDA, to which specific application programs are applied. Decision support at the tactical level is dependent on an initial mathematical (usually statistical) analysis of source data, a possible subsequent analysis utilizing "systems" techniques, and a final results judgment. While numerous analytic techniques, mathematical and systems,

are utilized by individual program planning offices, each is limited in its potential to serve an integrated NAVAIR tactical planning process.

A brief review of the primary systems analysis techniques illustrates the tactical planning limitations associated with each.

1. <u>Input-Output Analysis</u>

Input-output analysis is a valuable analytic technique. It has been used, historically, as a strategic planning tool. While it provides for the consideration of simultaneous and interactive relationships among numerous interdependent variables, it assumes fixed and proportionate relationships between input and output variables.

2. <u>Utility Theory</u>

Utility theory measures the value of outcomes in a "risk" environment. The theory assumes that a decision maker can translate his judgments about the utility of something to a cardinal scale and that the utility associated with decision variables is additive. "Expected utility" (decision costs/ benefits), is computed in the same way expected value is computed. While utility theory exploits judgment, it is limited to single attribute, or objective, problems. Application of the theory is extremely difficult in anything other than well-structured situations.

3. <u>Goal Programming</u>

Goal programming adapts linear programming to problem situations involving multiple objectives. In applying the

technique, objectives or goals are ranked in order of their judged importance. Then, through the programming process, allocation decisions are made which minimize deviations from the objectives. Goal programming assumes fixed and proportionate relationships among variables and is limited by the programming linearity requirement.

4. Delphi

Delphi is a statistical method by which "expert" opinion, or judgment, is exploited and a consensus of opinion achieved. The process involves anonymous questionnaires, a statistical review of responses, and follow-on anonymous requests for adjustments to initial responses. While the method has been used with impressive success in forecasting, the design of the questionnaire implies the choice of variables.

D. THE ANALYTIC HIERARCHY PROCESS (AHP)

Recent systems analysis research has resulted in a promising technique for "modeling" the readiness to resources problem. The Analytic Hierarchy Process (AHP) developed by Thomas L. Saaty represents the "state of the art" in the structuring of miltiple and conflicting goals and objectives. It provides a method for "...breaking down a complex, unstructured situation into its component parts; arranging (those) parts, or variables, into a hierarchic order; assigning numerical values to subjective judgments on the relative importance of each variable; and synthesizing the

judgments to determine which variables have the highest priority and should be acted upon to influence the outcome of the situation" [Ref. 37: p. 5].

Despite some disadvantages, to be discussed later, the process draws on the desireable characteristics of existing systems techniques. Like input-output analysis, AHP establishes proportionate relationships between numerous interdependent decision variables. The process translates judgment to a cardinal scale in much the same manner as utility theory. Like goal programming, AHP deals with multiple objectives. The process, like Delphi, is designed to output "expert opinion" consensus. While AHP obtains consensus through an open group discussion process, it is adaptable to the Delphi method. Unlike Delphi, AHP incorporates a consistency ratio which measures the consistency of "group consensus" judgments throughout a set of pairwise comparisons.

E. PROCESS DESCRIPTION

The following illustrated description of AHP is intended to provide a general understanding of the process. It is not a detailed explanation. For reference, Professor Saaty's book entitled The Analytic Hierarchy Process (see bibliography) reviews the principles of matrix and eigenvalue theory upon which the process is based. His later book entitled Decision Making for Leaders (see reference list) offers a practical guide to AHP.

1. Structuring the Hierarchy

The process begins by laying out elements of the problem in a hierarchical format. While there are no set procedures for accomplishing this, Saaty considers an open discussion between knowledgeable experts the most desireable technique. Problem objectives and as many elements of the problem as can be determined are identified. Following identification of the problem elements, elements are grouped into disjoint sets to form levels of the hierarchy. The hierarchy graphically depicts the independence and interdependence of problem elements: it both isolates the relevant factors and displays them in the larger context of their relationship to each other and the system as a whole. In the example, Figure VII-1, market researchers are tasked with determining the marketability of three brands of paper towels. They agree that absorption and price are the prime determiners and that those characteristics are evaluated independently by customers on a high, medium, or low basis. Three product brands, x, y, and z, are provided for evaluation. It is important to note the assumption that the decision makers are able to "measure" the performance of each brand. In this example, the direct correlation between price and absorption is coincidental.

2. Determining Priorities

After a hierarchy of problem elements has been agreed upon, a quantitative comparison of elements is conducted level

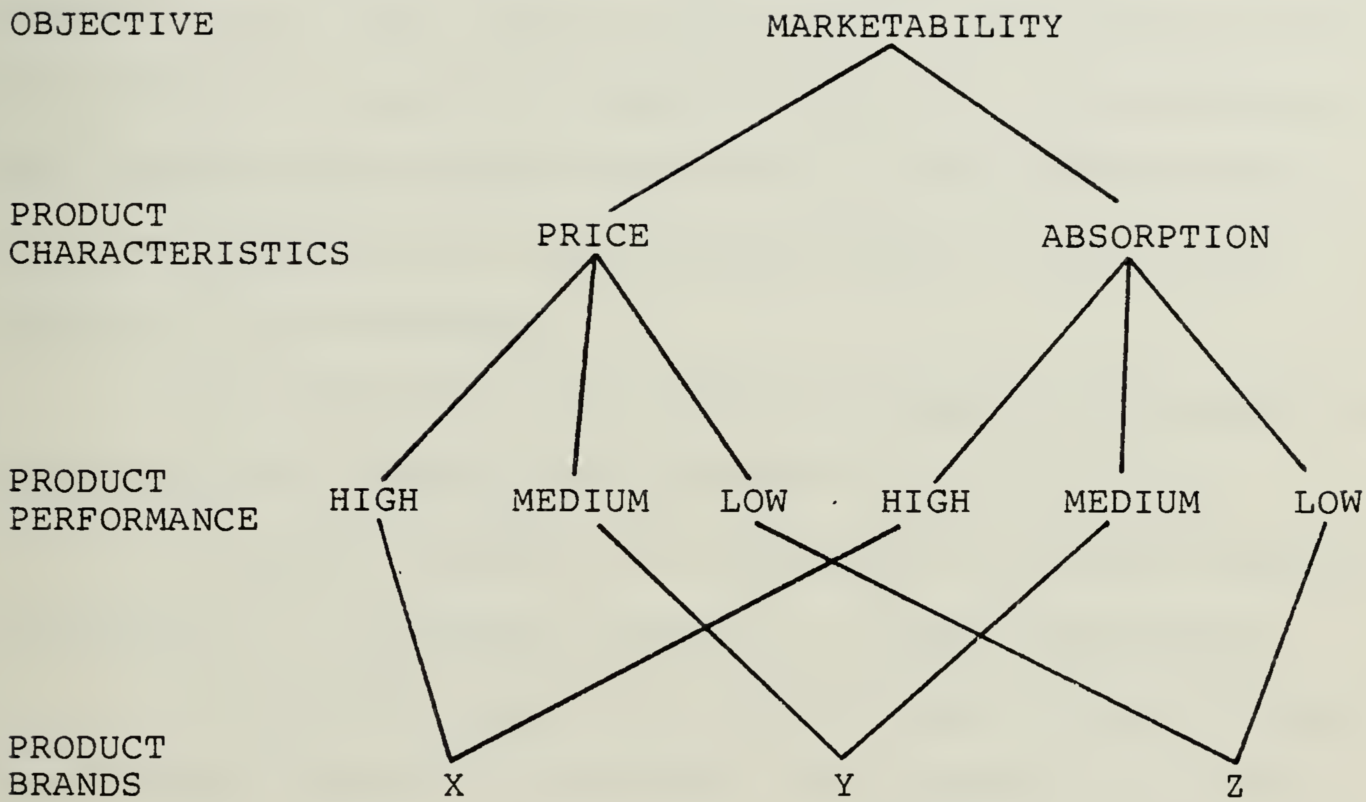


Figure VII-1. Marketability Hierarchy

by level. The technique used by Saaty involves pairwise comparisons of elements at one level of the hierarchy with respect to their importance to elements at the next higher level. Pairwise comparison judgments are quantified through reference to the pairwise comparison scale, Table VII-I.

Table VII-II presents, in matrix format, the pairwise comparisons for each level in the product marketability hierarchy above the decision alternatives level. Development of the "relative importance" matrices is accomplished by individually comparing left-hand column elements with top row elements. By convention:

* an element in the left-hand column is evaluated with respect to its dominance over elements in the top row.

* elements compared to themselves are always assigned an intensity of importance value of 1 (equal importance).

* reciprocal values are entered when a second comparison between elements is required with respect to the same objective. That is, if element x is assigned an intensity of importance value of 5 (essential or strong importance) over element y, then element y has an intensity of importance of 1/5 of element x.

In the first matrix presented in Table VII-II, market researchers agree, with respect to the marketability of paper towels, that price has an intensity of importance value of 5 (essential or strong importance) when compared to absorption. Absorption compared to price, then, is 1/5.

TABLE VII-I

PAIRWISE COMPARISON SCALE
[Ref. 37: p. 78]

Intensity of Importance	*Definition*	*Explanation*
1	Equal importance of both elements	Two elements contribute equally to the property
3	Weak importance of one element over another	Experience and judgment slightly favor one element over another
5	Essential or strong importance of one element over another	Experience and judgment strongly favor one element over another
7	Demonstrated importance of one element over another	An element is strongly favored and its dominance is demonstrated in practice
9	Absolute importance of one element over another	The evidence favoring one element over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between two adjacent judgments	Compromise is needed between two judgments
Reciprocals	If activity *i* has one of the preceding numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	

TABLE VII-II

LEVEL PAIRWISE COMPARISONS

1. MARKETABILITY	PRICE	ABSORPTION	EIGENVECTOR
Price	1	5	.83
Absorption	1/5	1	.17

2. PRICE	HIGH	MEDIUM	LOW	
High	1	1/5	1/7	.07
Medium	5	1	1/3	.28
Low	7	3	1	.64

$\lambda = 3.07$ C.I. = .035 C.R. = .06

3. ABSORPTION	HIGH	MEDIUM	LOW	
High	1	3	5	.63
Medium	1/3	1	3	.26
Low	1/5	1/3	1	.11

$\lambda = 3.04$ C.I. = .02 C.R. = .03

At the next level in the hierarchy, two matrices are required. One presents pairwise comparisons between product performance factors with respect to price. The other presents pairwise comparisons between product performance factors with respect to absorption. As might be expected, intensity of importance comparison values differ depending on which product characteristic they are being evaluated with respect to. In Table VII-II, for example, matrix 2 compares high, medium, and low product performance factors with respect to price. In row 3 of that example, a low price is assigned an intensity of importance value of 7 (demonstrated importance) over a high price. The same product performance factor comparison, high to low, conducted in matrix 3 with respect to absorption results in an intensity of importance value of 5 (essential or strong importance).

3. Synthesizing Priorities

Synthesizing pairwise judgments results in a priority vector for each matrix. This vector, or eigenvector, represents the relative priority of each element in the left-hand column with respect to the matrix objective. Eigenvector compution is a two step, matrix normalization and averaging, process. Normalization is accomplished by (a) totaling the values in each matrix column and (b) dividing each value by its respective column total. Following normalization, rows are averaged to obtain the eigenvector value for that left-hand element.

Eigenvectors are presented for each matrix in Table VII-II. In the matrix 1 (marketability) example, the relative importance of price is 83 percent while the relative importance of absorption is 17 percent. Eigenvector computations for matrix 1 are presented in Table VII-III.

4. Consistency Measures

The consistency of "group" judgments is concerned with the transitive and proportional relationships between judgments throughout the set of pairwise comparisons. For example, if characteristic A is twice as important as characteristic B in the first comparison, and characteristic B is three times as important as characteristic C in a second comparison, then characteristic A must be six times as important as characteristic C in a third comparison. Saaty refers to this as "cardinal" consistency in the strength of importance.

The uncertainty involved in judgments virtually precludes perfect consistency. While perfect consistency is forced in identical element comparisons (always the value 1) and transposed comparisons (always the reciprocal value), there is no process rule which assures perfect transitive and proportional consistency between several comparisons.

AHP measures the degree of inconsistency between a set of judgments on the assumption that as long as there is enough consistency to maintain coherence, the consistency need not be perfect. An eigenvalue is used to estimate the degree of deviation from perfect consistency through the

TABLE VII-III

EIGENVECTOR COMPUTATIONS

1. NORMALIZATION

MARKETABILITY	PRICE	ABSORPTION
Price	1	5
Absorption	.2	1
Column Totals	1.2	6

MARKETABILITY	PRICE	ABSORPTION
Price	1/1.2 (.834)	5/6 (.833)
Absorption	.2/1.2 (.167)	1/6 (.167)

2. ROW AVERAGING

EIGENVECTOR

$$\begin{array}{rcl} (.834 + .833) & = & \\ (.167 + .167) & = & \end{array} \begin{pmatrix} .83 \\ .17 \end{pmatrix}$$

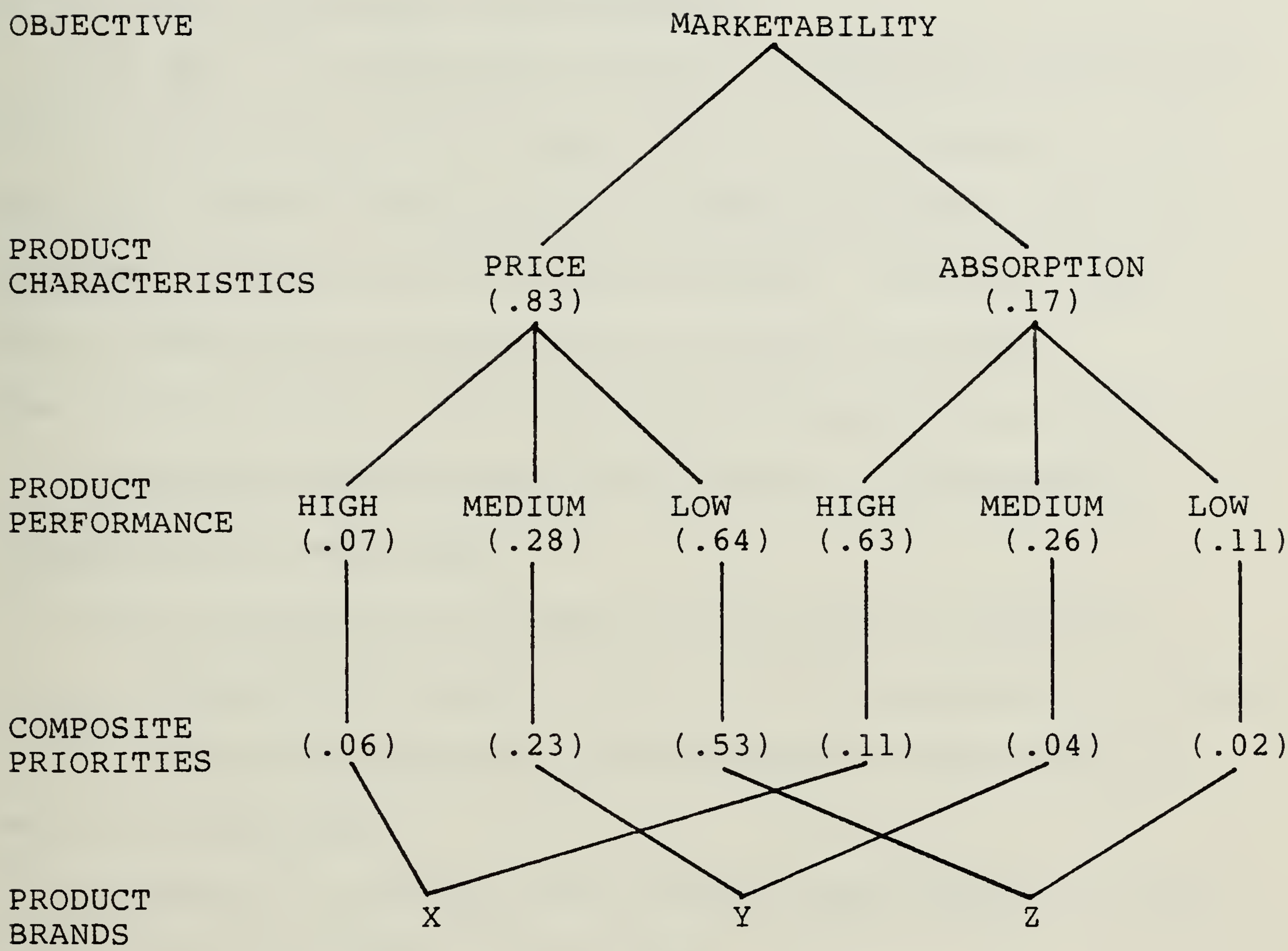
mathematical computation of a consistency index and the subsequent computation of a consistency ratio. Eigenvalues (λ), consistency indices (C.I.), and consistency ratios (C.R.) are presented for matrices 2 and 3 of Table VII-II as several pairwise comparisons are involved. The first matrix is perfectly consistent. Saaty considers consistency ratios less than or equal to .10 to be acceptable. Ratios greater than .10 indicate excessive randomness between judgments. In the case of ratios $>.10$, consideration should be given to restructuring the hierarchy or reviewing the judgments or both.

5. Composite Priorities

The next step in the Analytic Hierarchy Process is the calculation of a composite priority vector for the individual matrix eigenvectors. This is accomplished by weighing each set of values by the priority of the elements they serve in the next higher level. In Figure VII-2, the resulting row vector of composite priorities preserves the priorities established at every level in the hierarchy. The composite priorities at the product performance factor level indicate the highest market preference for low price (.53), with medium price ranked second (.23), and high absorption ranked third (.11).

6. Evaluating Alternatives

The final step involves the evaluation of alternatives. In Figure VII-2, product priorities for each brand have been computed as the sum of their composite priority vector elements.



Brand X = .17
Brand Y = .27
Brand Z = .55

Figure VII-2. Composite Priority Hierarchy

The product priorities suggest to the researchers that the marketability of brand z is twice that of brand y and three times that of brand x.

F. PROCESS ADVANTAGES/DISADVANTAGES

The AHP is a management process of "systemic rationality". It provides the decision makers with a "...framework...for analyzing complex policy issues, where objectives and other decision criteria may be vaguely defined, and where there may be conflicting views on how to resolve problems" [Ref. 36: p. 5-17]. The primary advantages of the process include:

* problem element structuring through a hierarchical integration of functions.
* the integration of deductive and systems approaches.
* a process for dealing with the interdependence of elements.
* a system for measuring intangibles and establishing relative priorities.
* a method of tracking the logical consistency of judgments used in determing priorities.
* a method for employing open group discussion or Delphi techniques to obtain or review "expert" consensus.
* a process by which decision alternatives can be incorporated into a hierarchy at the lowest level and evaluated on the basis of a composite priority.

The Analytic Hierarchy Process is limited by:

* the basic assumption that a system or problem can be broken down into disjoint levels of independent elements.

* problems associated with coordinating expert commitment to and participation in the process.

* difficulties associated with arriving at a consensus on all problem elements. A lack of consensus on pairwise comparisons can be resolved in some instances through the use of the geometric mean.

* the requirement for computer programming assistance in the calculation of eigenvalues and eigenvectors for large matrices.

G. AHP, APMS, AND THE NAVAIR PLANNING PROBLEM

AHP provides a framework and a method through which readiness standards may be linked to "I" level performance measures.

1. Framework

To illustrate the potential applicability of AHP to the "I" level planning problem, the preparedness section of the readiness taxonomy, presented in Figure II-1, will be developed as an illustration. This section of the taxonomy was chosen specifically because APMS provides performance measures related directly to preparedness. Figure VII-3 is a graphical depiction of the preparedness hierarchy. In the illustration, preparedness, an objective element, is considered to be a function of several things: weapon systems (program elements); how essential components inducted into the AIMD for repair are to the mission capability of those

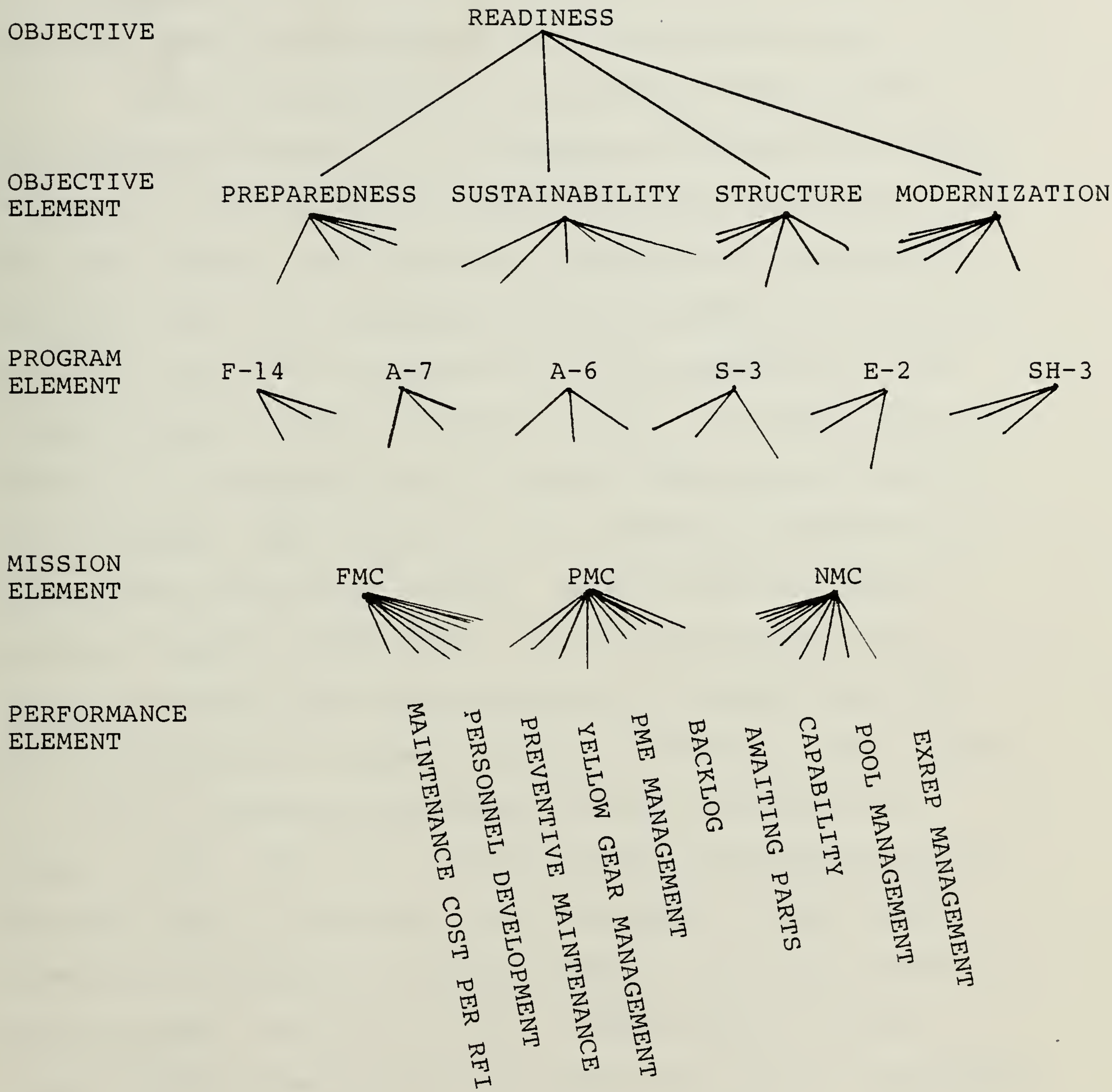


Figure VII-3. Preparedness Hierarchy

weapon systems (mission elements); and how well AIMD repairs the components inducted (performance indices). In effect, SCIR EOC codes are extended to the intermediate level.

Prior to discussion of the various levels in the preparedness hierarchy, it is necessary to explain the basic assumption that was made in developing the illustration. It has been assumed that the mission essentiality associated with the repair of a component at the intermediate level is equal to the mission essentiality of the component to the weapons system at the operational level. In others words, if failure of a component in an aircraft results in a "not mission capable" (NMC) aircraft, that component, whether or not it has been replaced by a spare, should retain a "mission critical" repair priority for resource planning purposes. It is recognized that mission-essential subsystem matrices and, consequently, equipment operating condition (EOC) codes "...are not intended to determine supply system priorities..." [Ref. 38: p. 5]. Nevertheless, OPNAV guidance permits EOC codes to be used "...as criterion in determining Item Mission Essentiality Codes (IMEC's) for supply management purposes" [Ref. 38: p. 5]. In the absence of Naval Supply Systems Command IMEC procedures for aviation components, it is argued that planners should, as a minimum, "...give greater...support to...components whose military worth is high..., all other things being equal" [Ref. 39: p. B-440] through the use of EOC codes.

The NAVAIR objective, presented at the top of Figure VII-3, establishes an overall logistics planning purpose. That objective, represented by annual CNO mission capability goals, can be stated as follows: to plan the allocation of "I" level resources so as to achieve and maintain the "mission capable" standards established by the CNO.

At the second level of the hierarchy, elements of the objective are identified. In the illustration, the readiness elements discussed in Chapter II are presented. Preparedness, defined as the ability of intermediate maintenance activities to repair aircraft components, is independent of sustainability (supply support), force structure, and force modernization. In spite of the fact that the objective elements represent broad concepts and are not directly measureable, they are easily incorporated into the AHP hierarchy.

The program element level of the hierarchy is relatively easy to establish. As discussed in Chapter VI, the relative importance of each weapons system is considered in the annual process of determining mission capable goals. Those factors can be utilized in determining the pairwise comparison values associated with component repair support priorities for individual weapons systems.

At the mission element level, component essentiality is considered. Failed components which result in a complete loss of aircraft mission capability (NMC) are compared with

those which result in only a partial loss (PMC) and those which do not impact mission capability (FMC).

The performance level of the hierarchy is composed of those APMS performance indices which are related to preparedness. From Figure VI-3, those 2nd level diagnostic indices which comprise the Resource Management Index and the Production Performance Index are combined with the 1st level Maintenance Production Cost per RFI Index as composite preparedness measures.

Once a structure of preparedness has been agreed upon, the AHP steps of priority weighing, consistency measurement, and composite priority determination can be applied.

2. Method

NAMP planning is particularly suited to the AHP method. In the first place, NAMP policies are reviewed annually by program experts who gather in an open forum under the direction of the NAMP policy committee. An extension of that planning forum's responsibilities to include the development and review of resource allocation planning priorities appears to be a logical and particularly valuable "policy" opportunity. Secondly, the program office structure of NAVAIR supports the AHP method. Office responsibilities, for the most part, match the performance index breakdowns. For example, NAVAIR planners assigned responsibility for Precision Measuring Equipment (PME) have extensive information on the condition, calibration, and availability of that equipment. What they do not have is

performance information associated with the essentiality, or priority, of that equipment to the repair of NMC, PMC, and FMC components. Through the AHP, an application of a standard method to various aircraft and EOC code data sorts provides a method for obtaining that information.

H. OTHER PROJECTED USES

There are several other potentially valuable uses for the AHP "model". In each instance the composite priorities would be evaluated against performance indices and operational level "mission capable" rates.

1. System Resource Allocations

The primary worth of the model appears to be associated with improved resource management. Through its use, NAVAIR planners would not only be able to determine program strengths/weaknesses, they would be able to assess those strengths/weaknesses on the basis of their importance to weapons system readiness. Comparisons between the performance of support programs and the mission capability of weapons systems would provide historical and trend information upon which "readiness oriented" resource allocation/reallocation decisions could be based.

2. Program Resource Allocations

Through aircraft type equipment code data sorts, the AHP structure could be utilized to evaluate a program's performance with respect to a single weapon system. Further information sorts by EOC codes could provide a prioritized

evaluation of a program's performance with respect to FMC, PMC, and NMC aircraft conditions.

3. Organizational Evaluation

AHP structuring of the readiness to resources problem provides an opportunity for development of an "objective" AIMD performance measurement system. By eliminating the weapon system level of the hierarchy (in effect, assuming equal importance of weapon systems) one AIMD's performance could be compared to another's. The sum of composite priority values times the percent performance in each area would result in a composite score. Levels of activity measures would give way to an emphasis on levels of repair activity with regard to the essentiality of the component.

VIII. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

Research conducted in conjunction with this study has consisted principally of a review and analysis of NAMP program reports information and contemporary information/decision systems theory. An attempt has been made to provide a systems perspective to the NAMP intermediate repair "readiness to resources" problem. Numerous NAMP program initiatives deal with functional elements of the specific "I" level planning problem. It is suggested that structuring of the problem elements is required before any program initiatives can be expected to provide measureable resource allocation inprovements. The study has demonstrated the use of the Analytic Hierarchy Process (AHP) "model" as a technique for integrating program elements throughout all levels of management. More importantly, the study has emphasized that today, "...when a naval task group goes to sea, its (capability) ...will depend on factors imposed by...policy makers who over the last several years have allocated financial resources in ways that largely determine the Task Group Commander's ability to make his force ready" [Ref. 40: p. 21].

B. CONCLUSIONS

The following conclusions are presented:

1. NAVAIR planners tasked with budgeting intermediate level support for the Naval Aviation Plan face an extremely

difficult assignment. Responsible for costing "what if?" resource requirements in support of a "readiness" objective, they must operate in an obscure environment in which readiness is not defined in terms of its elements but is instead represented by an operational measure not directly related to "I" level performance. The absence of a defined objective has resulted in obscure performance goals, a "fall back" emphasis on operational efficiency (level of activity measures), and suboptimization of support elements.

2. The existing "I" level planning process is supported by a complexly integrated information system (3-M) which makes aggregated information available to NAVAIR application programs. 3-M program emphasis, reflected in the NALCOMIS/ NALDA program initiatives, continues to be on the collection and distribution of information. While equipment repair data, including cost data, is available through 3-M, the system does not incorporate standard "I" level measures of performance relative to the mission essentiality of equipment.

3. Recognition by OPNAV of the requirement for a "systems" approach to the "I" level readiness to resources problem resulted in the establishment of AIMSO. Tasked with developing the "methods link", AIMSO, through the LMI, has made tremendous progress in defining AIMD performance measures. The AIMD Performance Management System (APMS), initially being developed for use at the operational level, provides a

performance related foundation upon which a tactical planning, readiness to resource, decision support framework can be based.

4. The Analytic Hierarchy Process (AHP) offers exceptional promise for conducting an analysis of complex logistics problems. Based on hierarchical structuring, the "model" integrates performance indices with institutional knowledge (judgment), considers multiple objectives at each level in directing managerial analysis toward a unified focus, and provides a consistency measure throughout.

C. RECOMMENDATIONS

The following recommendations are offered:

1. It is recommended that AIMSO expand current "I" level programs research to include: (1) development of a tactical decision support framework for NAMP planning; (2) development of sustainability, force structure, and force modernization "performance" measures; and (3) an evaluation of the Analytic Hierarchy Process (AHP) as a technique for integrating readiness/resource planning. Consideration should be given to accomplishing this research through an extension of the Aircraft Intermediate Maintenance Department (AIMD) performance measures research program currently contracted to the Logistics Management Institute.

2. It is recommended that OPNAV planners begin tailoring NALCOMIS (source data collection and program application systems) to provide for a rapid fleet introduction of APMS.

3. In the absence of an "I" level repair item essentiality coding system, it is recommended that the NAMP policy committee consider incorporating SCIR EOC coding into "I" level documentation procedures. Resource requirements planning as a minimum must be capable of approximating the full mission capable (FMC), partial mission capable (PMC), and not mission capable (NMC) impact of "I" level component maintenance/ supply support initiatives on weapons systems.

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